SSRF
692

NOAA Technical Report NMFS SSRF-692

Expendable Bathythermograph Observations from the NMFS/MARAD Ship of Opportunity Program for 1972

STEVEN K. COOK

SEATTLE, WA
June 1975

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / National Marine Fisheries Service

NOAA TECHNICAL REPORTS

National Marine Fisheries Service, Special Scientific Report—Fisheries Series

The major responsibilities of the National Marine Fisheries Service (NMFS) are to monitor and assess the abundance and geographic distribution of fishery resources, to understand and predict fluctuations in the quantity and distribution of these resources, and to establish levels for optimum use of the resources. NMFS is also charged with the development and implementation of policies for managing national fishing grounds, development and enforcement of domestic fisheries regulations, surveillance of foreign fishing off United States coastal waters, and the development and enforcement of international fishery agreements and policies. NMFS also assists the fishing industry through marketing service and economic analysis programs, and mortgage insurance and vessel construction subsidies. It collects, analyzes, and publishes statistics on various phases of the industry.

The Special Scientific Report—Fisheries series was established in 1949. The series carries reports on scientific investigations that document long-term continuing programs of NMFS, or intensive scientific reports on studies of restricted scope. The reports may deal with applied fishery problems. The series is also used as a medium for the publication of bibliographies of a specialized scientific nature.

NOAA Technical Reports NMFS SSRF are available free in limited numbers to governmental agencies, both Federal and State. They are also available in exchange for other scientific and technical publications in the marine sciences. Individual copies may be obtained (unless otherwise noted) from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, D.C. 20235. Recent SSRF's are:

619. Macrozooplankton and small nekton in the coastal waters off Vancouver Island (Canada) and Washington, spring and fall of 1963. By Donald S. Day, January 1971, iii + 94 pp., 19 figs., 13 tables.

620. The Trade Wind Zone Oceanography Pilot Study. Part IX: The sea-level wind field and wind stress values, July 1963 to June 1965. By Gunter R. Seckel. June 1970, iii + 66 pp., 5 figs.

621. Predation by sculpins on fall chinook salmon, *Oncorhynchus tshawytscha*, fry of hatchery origin. By Benjamin G. Patten. February 1971, iii + 14 pp., 6 figs., 9 tables.

622. Number and lengths, by season, of fishes caught with an otter trawl near Woods Hole, Massachusetts, September 1961 to December 1962. By F. E. Lux and F. E. Nichy. February 1971, iii + 15 pp., 3 figs., 19 tables.

623. Apparent abundance, distribution, and migrations of albacore, *Thunnus alalunga*, on the North Pacific longline grounds. By Brian J. Rothschild and Marian Y. Y. Yong. September 1970, v + 37 pp., 19 figs., 5 tables.

624. Influence of mechanical processing on the quality and yield of bay scallop meats. By N. B. Webb and F. B. Thomas. April 1971, iii + 11 pp., 9 figs., 3 tables.

625. Distribution of salmon and related oceanographic features in the North Pacific Ocean, spring 1968. By Robert R. French, Richard G. Bakkala, Masanao Osako, and Jun Ito. March 1971, iii + 22 pp., 19 figs., 3 tables.

626. Commercial fishery and biology of the freshwater shrimp, *Macrobrachium*, in the Lower St. Paul River, Liberia, 1952-53. By George C. Miller. February 1971, iii + 13 pp., 8 figs., 7 tables.

627. Calico scallops of the Southeastern United States, 1959-69. By Robert Cummins, Jr. June 1971, iii + 22 pp., 23 figs., 3 tables.

628. Fur Seal Investigations, 1969. By NMFS, Marine Mammal Biological Laboratory. August 1971, 82 pp., 20 figs., 44 tables, 23 appendix A tables, 10 appendix B tables.

629. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967. By Richard N. Uchida and Ray F. Sumida. March 1971, v + 25 pp., 14 figs., 21 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

630. Blue crab meat. I. Preservation by freezing. July 1971, iii + 13 pp., 5 figs., 2 tables. II. Effect of chemical treatments on acceptability. By Jurgen H. Strasser, Jean S. Lennon, and Frederick J. King. July 1971, iii + 12 pp., 1 fig., 9 tables.

631. Occurrence of thiaminase in some common aquatic animals of the United States and Canada. By R. A. Greig and R. H. Gnaedinger. July 1971, iii + 7 pp., 2 tables.

632. An annotated bibliography of attempts to rear the larvae of marine fishes in the laboratory. By Robert C. May. August 1971, iii + 24 pp., 1 appendix I table, 1 appendix II table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

633. Blueing of processed crab meat. II. Identification of some factors involved in the blue discoloration of canned crab meat *Callinectès sapidus*. By Melvin E. Waters. May 1971, iii + 7 pp., 1 fig., 3 tables.

634. Age composition, weight, length, and sex of herring, *Clupea pallasii*, used for reduction in Alaska, 1929-66. By Gerald M. Reid. July 1971, iii + 25 pp., 4 figs., 18 tables.

635. A bibliography of the blackfin tuna, *Thunnus atlanticus* (Lesson). By Grant Beardsley and David C. Simmons. August 1971, 10 pp. For sale by the Superintendent Documents, U.S. Government Printing Office, Washington, D.C. 20402.

636. Oil pollution on Wake Island from the tanker *R. C. Stoner*. By Reginald M. Gooding. May 1971, iii + 12 pp., 8 figs., 2 tables. For sale by the Superintendent Documents, U.S. Government Printing Office, Washington, D.C. 20402.

637. Occurrence of larval, juvenile, and mature crabs in the vicinity of Beaufort Inlet, North Carolina. By Donnie L. Dudley and Mayo H. Judy. August 1971, iii + 10 pp., 1 fig., 5 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

638. Length-weight relations of haddock from commercial landings in New England, 1931-55. By Bradford E. Brown and Richard C. Hennemuth. August 1971, v + 13 pp., 16 figs., 6 tables, 10 appendix A tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

639. A hydrographic survey of the Galveston Bay system, Texas 1963-66. By E. J. Pullen, W. L. Trent, and G. B. Adams. October 1971, v + 13 pp., 15 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

640. Annotated bibliography on the fishing industry and biology of the blue crab, *Callinectes sapidus*. By Marlin E. Tagatz and Ann Bowman Hall. August 1971, 94 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

641. Use of threadfin shad, *Dorosoma petenense*, as live bait during experimental pole-and-line fishing for skipjack tuna, *Katsuwonus pelamis*, in Hawaii. By Robert T. Iversen. August 1971, iii + 10 pp., 3 figs., 7 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

642. Atlantic menhaden *Brevoortia tyrannus* resource and fishery—analysis of decline. By Kenneth A. Henry. August 1971, v + 32 pp., 40 figs., 5 appendix figs., 3 tables, 3 appendix tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

643. Surface winds of the southeastern tropical Atlantic Ocean. By John M. Steigner and Merton C. Ingham. October 1971, iii + 20 pp., 17 figs. For sale by the Superintendent Documents, U.S. Government Printing Office, Washington, D.C. 20402.

644. Inhibition of flesh browning and skin color fading in frozen fillets of yelloweye snapper (*Lutzanus vivanus*). By Harold C. Thompson, Jr., and Mary H. Thompson. February 1972, iii + 6 pp., 3 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

645. Traveling screen for removal of debris from rivers. By Daniel W. Bates, Ernest W. Murphey, and Martin G. Beam. October 1971, iii + 6 pp., 6 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

646. Dissolved nitrogen concentrations in the Columbia and Snake Rivers in 1970 and their effect on chinook salmon and steelhead trout. By Wesley J. Ebel. August 1971, iii + 7 pp., 2 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

647. Revised annotated list of parasites from sea mammals caught off the west coast of North America. By L. Margolis and M. D. Dailey. March 1972, iii + 23 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Continued on inside back cover.

NOAA Technical Report NMFS SSRF-692

Expendable Bathythermograph Observations from the NMFS/MARAD Ship of Opportunity Program for 1972

STEVEN K. COOK

SEATTLE, WA
June 1975

UNITED STATES
DEPARTMENT OF COMMERCE
Rogers C. B. Morton, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

National Marine
Fisheries Service
Robert W. Schoning, Director

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

CONTENTS

	Page
Introduction	1
Areas of study	1
Data acquisition and processing	1
Discussion	1
Acknowledgments	1
Figures	2

Figures

1.	Sea surface temperature, 25-28 February 1972	3
2.	Sea surface salinities, 25-28 February 1972	4
3.	Vertical distribution of temperature, 25-28 February 1972	5
4.	Sea surface temperature, 26-28 March 1972	6
5.	Sea surface salinities, 26-28 March 1972	7
6.	Vertical distribution of temperature, 26-28 March 1972	8
7.	Sea surface temperature, 30 April-4 May 1972	9
8.	Sea surface salinities, 30 April-4 May 1972	10
9.	Vertical distribution of temperature, 30 April-4 May 1972	11
10.	Sea surface temperature, 6-7 June 1972	12
11.	Sea surface salinities, 6-7 June 1972	13
12.	Vertical distribution of temperature, 6-7 June 1972	14
13.	Sea surface temperature, 21-28 August 1972	15
14.	Sea surface salinities, 21-28 August 1972	16
15.	Vertical distribution of temperature, 21-28 August 1972	17
16.	Sea surface temperature, 14-18 November 1972	18
17.	Sea surface salinities, 14-18 November 1972	19
18.	Vertical distribution of temperature, 14-18 November 1972	20
19.	Sea surface temperature, 27 January-1 February 1972	21
20.	Sea surface salinities, 27 January-1 February 1972	22
21.	Vertical distribution of temperature, 27 January-1 February 1972	23
22.	Sea surface temperature, 10-14 February 1972	24
23.	Sea surface salinities, 10-14 February 1972	25
24.	Vertical distribution of temperature, 10-14 February 1972	26
25.	Sea surface temperature, 19-23 February 1972	27
26.	Sea surface salinities, 19-23 February 1972	28
27.	Vertical distribution of temperature, 19-23 February 1972	29
28.	Sea surface temperature, 13-25 March 1972	30
29.	Vertical distribution of temperature, 13-25 March 1972	31
30.	Sea surface temperature, 26-29 March 1972	32
31.	Vertical distribution of temperature, 26-29 March 1972	33
32.	Sea surface temperature, 1-3 April 1972	34
33.	Vertical distribution of temperature, 1-3 April 1972	35
34.	Sea surface temperature, 9-17 April 1972	36
35.	Vertical distribution of temperature, 9-17 April 1972	37
36.	Sea surface temperature, 4-8 April 1972	38
37.	Vertical distribution of temperature, 4-8 April 1972	39
38.	Sea surface temperature, 1-5 May 1972	40
39.	Vertical distribution of temperature, 1-5 May 1972	41
40.	Sea surface temperature, 20-25 May 1972	42
41.	Vertical distribution of temperature, 20-25 May 1972	43
42.	Sea surface temperature, 29 May-8 June 1972	44
43.	Sea surface salinities, 29 May-8 June 1972	45
44.	Vertical distribution of temperature, 29 May-8 June 1972	46
45.	Sea surface temperature, 8-18 June 1972	47
46.	Sea surface salinities, 8-18 June 1972	48
47.	Vertical distribution of temperature, 8-18 June 1972	49
48.	Sea surface temperature, 28 June-14 July 1972	50
49.	Sea surface salinities, 28 June-14 July 1972	51
50.	Vertical distribution of temperature, 28 June-14 July 1972	52
51.	Sea surface temperature, 15-18 July 1972	53
52.	Vertical distribution of temperature, 15-18 July 1972	54
53.	Sea surface temperature, 25-31 July 1972	55

54. Sea surface salinities, 25-31 July 1972 56
55. Vertical distribution of temperature, 25-31 July 1972 57
56. Sea surface temperature, 11-14 August 1972 58
57. Sea surface salinities, 11-14 August 1972 59
58. Vertical distribution of temperature, 11-14 August 1972 60
59. Sea surface temperature, 21 August-1 September 1972 61
60. Sea surface salinities, 21 August-1 September 1972 62
61. Vertical distribution of temperature, 21 August-1 September 1972 63
62. Sea surface temperature, 2-13 September 1972 64
63. Sea surface salinities, 2-13 September 1972 65
64. Vertical distribution of temperature, 2-13 September 1972 66
65. Sea surface temperature, 17-30 September 1972 67
66. Sea surface salinities, 17-30 September 1972 67
67. Vertical distribution of temperature, 17-30 September 1972 68
68. Sea surface temperature, 30 September-9 October 1972 69
69. Sea surface salinities, 30 September-9 October 1972 70
70. Vertical distribution of temperature, 30 September-9 October 1972 71
71. Sea surface temperature, 4-13 October 1972 72
72. Sea surface salinities, 4-13 October 1972 73
73. Vertical distribution of temperature, 4-13 October 1972 74
74. Sea surface temperature, 15-18 October 1972 75
75. Sea surface salinities, 15-18 October 1972 76
76. Sea surface temperature, 15-18 October 1972 77
77. Sea surface salinities, 15-18 October 1972 77
78. Vertical distribution of temperature, 15-18 October 1972 78
79. Sea surface temperature, 3-5 November 1972 79
80. Sea surface salinities, 3-5 November 1972 80
81. Vertical distribution of temperature, 3-5 November 1972 81

Expendable Bathythermograph Observations from the NMFS/MARAD Ship of Opportunity Program for 1972

STEVEN K. COOK[1]

ABSTRACT

Results of the second year of operation of the NMFS/MARAD Ship of Opportunity Program are presented in the form of vertical distributions of temperature and horizontal distributions of sea surface salinity and temperature. Operational and data management procedures also are discussed.

INTRODUCTION

In midyear of 1970 a cooperative expendable bathythermograph (XBT) program was initiated between the National Marine Fisheries Service (NMFS) and the Maritime Administration (MARAD) of the U.S. Department of Commerce. The program, conducted in support of the Marine Resources Monitoring Assessment and Prediction Program of NMFS, involved the use of Maritime Cadets from the Kings Point Maritime Academy to gather XBT data on board various merchant ships along the east and Gulf coasts of the United States. The objective of this cooperative program was to identify and describe seasonal and year-to-year variations of temperature and circulation in major currents of the tropical Atlantic, Caribbean Sea, Gulf of Mexico, and western North Atlantic, utilizing merchant ships as relatively inexpensive platforms for the collection of data.

The processed data were used to construct vertical sections of temperature and horizontal plots of sea surface temperature and salinity. The final form of the vertical and horizontal sections (Figs. 1-81) are printed in this report.

Approximately 75 more XBT drops and associated surface data were collected but are not represented in this report because the observations were much too scattered in time and space to be formed into transects. All data collected, whether represented in this report or not, were archived by the National Oceanographic Data Center (NODC) and are available to interested persons through the NODC, Washington, D.C. 20235.

Further details concerning the acquisition or processing of data from the cruises considered here can be obtained from the author.

AREAS OF STUDY

Ship routes were selected to obtain regular sampling in the most dynamic areas of the Gulf of Mexico, Caribbean Sea, and western tropical Atlantic Ocean; namely, the Yucatan Channel, Straits of Florida, and the Antilles, Equatorial, and Guiana currents. Repeated coverage is important for comparative analysis, so ships with the most regular schedules were chosen.

[1] Atlantic Environmental Group, National Marine Fisheries Service, NOAA, R.R. 7A, Box 522-A, Narragansett, RI 02882.

DATA ACQUISITION AND PROCESSING

Subsurface temperature data were obtained by use of Sippican XBT systems. At the same time surface water samples were collected with bucket thermometer units for later analysis to determine salinity. This procedure also provided a surface reference temperature necessary for the calculation of surface density or sigma-*t*. The surface water samples were analyzed on shore using a Beckman inductive salinometer calibrated with standard (Copenhagen) water at least once per 30 samples.

The XBT traces from approximately the first half of the year were digitized, key punched, and quality controlled by NMFS personnel. Those from the balance of the year were digitized and key punched by NODC personnel. The data from both halves of the year were then submitted to NODC for further processing and listing.

DISCUSSION

This second year of operation of the NMFS/MARAD Ship of Opportunity Program was highlighted by two events. The first was the commencement of involvement of NODC in the processing of the Ship of Opportunity data. Programs are being developed at NODC to process these data from the analog traces to computer plots within a 10- to 14-day turnaround time. While this program is not completely operational at this writing, it is expected to be in time for the 1973 report.

The second event was the increase in data collected by the MARAD cadets. The utilization of two more ships, one out of New York and one out of New Orleans, allowed for a 25% increase in data collected over 1971. The addition of two ships yielded a total of six (three out of New York and three out of New Orleans) involved with the program.

Future program improvements should take the form of more intense coverage over a smaller geographical area. Discussions held in late 1972 led to a decision to reduce the area to be covered and increase the density of XBT drops in 1973. This should yield data more useful for fisheries research.

ACKNOWLEDGMENTS

Appreciation is extended to the Maritime Academy Training Representatives in New York and New Orleans, M.

Chicurel and D. Thompson, for their diligent efforts to place cadets on board ships that were scheduled to traverse preselected oceanic areas. In addition, thanks are extended to the Moore McCormack Lines and Grace Prudential Lines of New York and the Delta Steamship Company and Lykes Brothers Lines of New Orleans whose full and courteous cooperation was essential for the success of this program.

FIGURES

The figures are grouped by geographical location and time. They consist of two horizontal maps and one vertical section for each transect of each ship. The two horizontal maps include station location with sea surface temperature in °C, and station location with sea surface salinity in ‰. The vertical cross section consists of temperature at whole degree isotherms in °C and depth in meters.

GULF OF MEXICO AND CARIBBEAN TRANSECTS

Figures	Vessels	Date (1972)
1-3	*Gulf Shipper*	25-28 Feb.
4-6	*Gulf Shipper*	26-28 Mar.
7-9	*Gulf Shipper*	30 Apr.-4 May
10-12	*Gulf Shipper*	6- 7 June
13-15	*Gulf Shipper*	21-28 Aug.
16-18	*Delta Argentina*	14-18 Nov.

WESTERN ATLANTIC AND EASTERN CARIBBEAN TRANSECTS

19-21	*Mormac Trade*	27 Jan.-1 F
22-24	*Bay State*	10-14 Feb.
25-27	*Bay State*	19-23 Feb.
28-29	*Santa Cruz*	13-25 Mar.
30-31	*Santa Cruz*	26-29 Mar.
32-33	*Delta Brazil*	1- 3 Apr.
34-35	*Mormac Cape*	9-17 Apr.
36-37	*Santa Cruz*	4- 8 Apr.
38-39	*Santa Cruz*	1- 5 May
40-41	*Mormac Cape*	20-25 May
42-44	*Santa Cruz*	29 May-8 Ju
45-47	*Santa Cruz*	8-18 June
48-50	*Santa Cruz*	28 June-14 J
51-52	*Santa Cruz*	15-18 July
53-55	*Santa Cruz*	25-31 July
56-58	*Santa Cruz*	11-14 Aug.
59-61	*Santa Cruz*	21 Aug.-1 S
62-64	*Santa Cruz*	2-13 Sept.
65-67	*Santa Cruz*	17-30 Sept.
68-70	*Santa Cruz*	30 Sept.-9 O
71-73	*Mormac Pride*	4-13 Oct.
74-78	*Santa Cruz*	15-18 Oct.
79-81	*Santa Cruz*	3- 5 Nov.

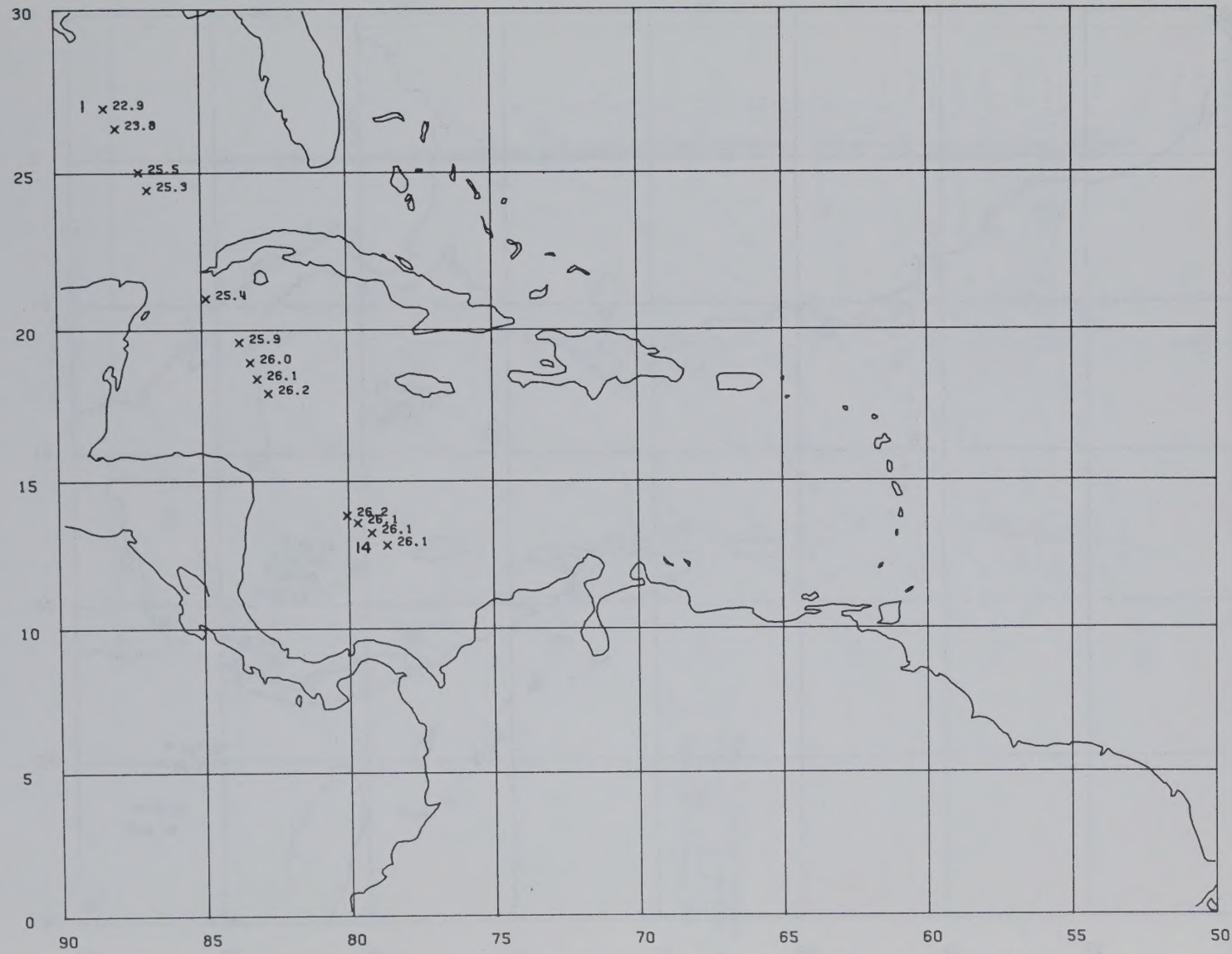
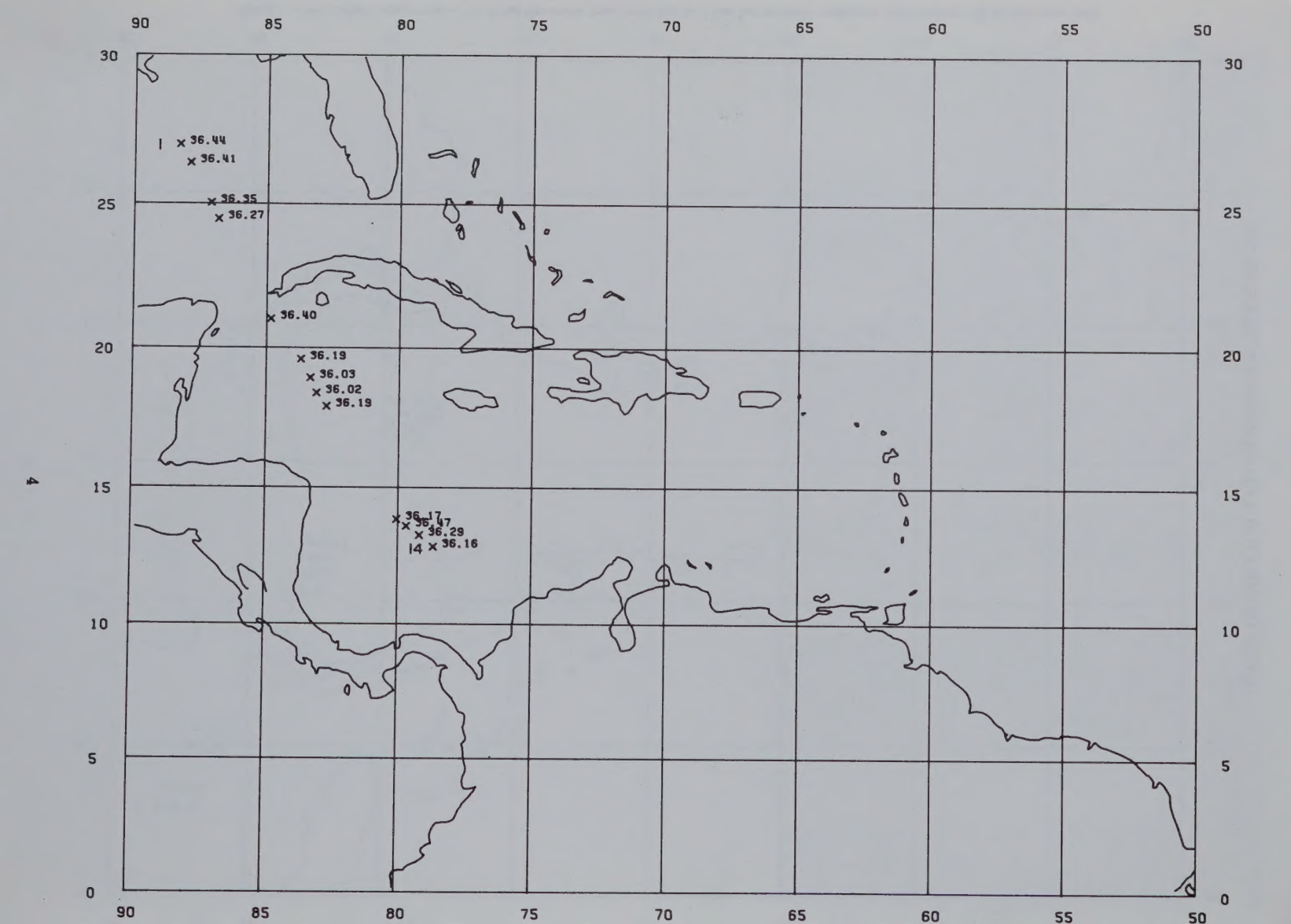


Figure 1.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper,* **25-28 February 1972.**


90
85
80
75
70
65
60
55
50
30
25
20
15
10
5
0
1 x 36.44
x 36.41
x 36.35
x 36.27
x 36.40
x 36.19
x 36.03
x 36.02
x 36.19
x 36.17
x 36.47
x 36.29
14 x 36.16

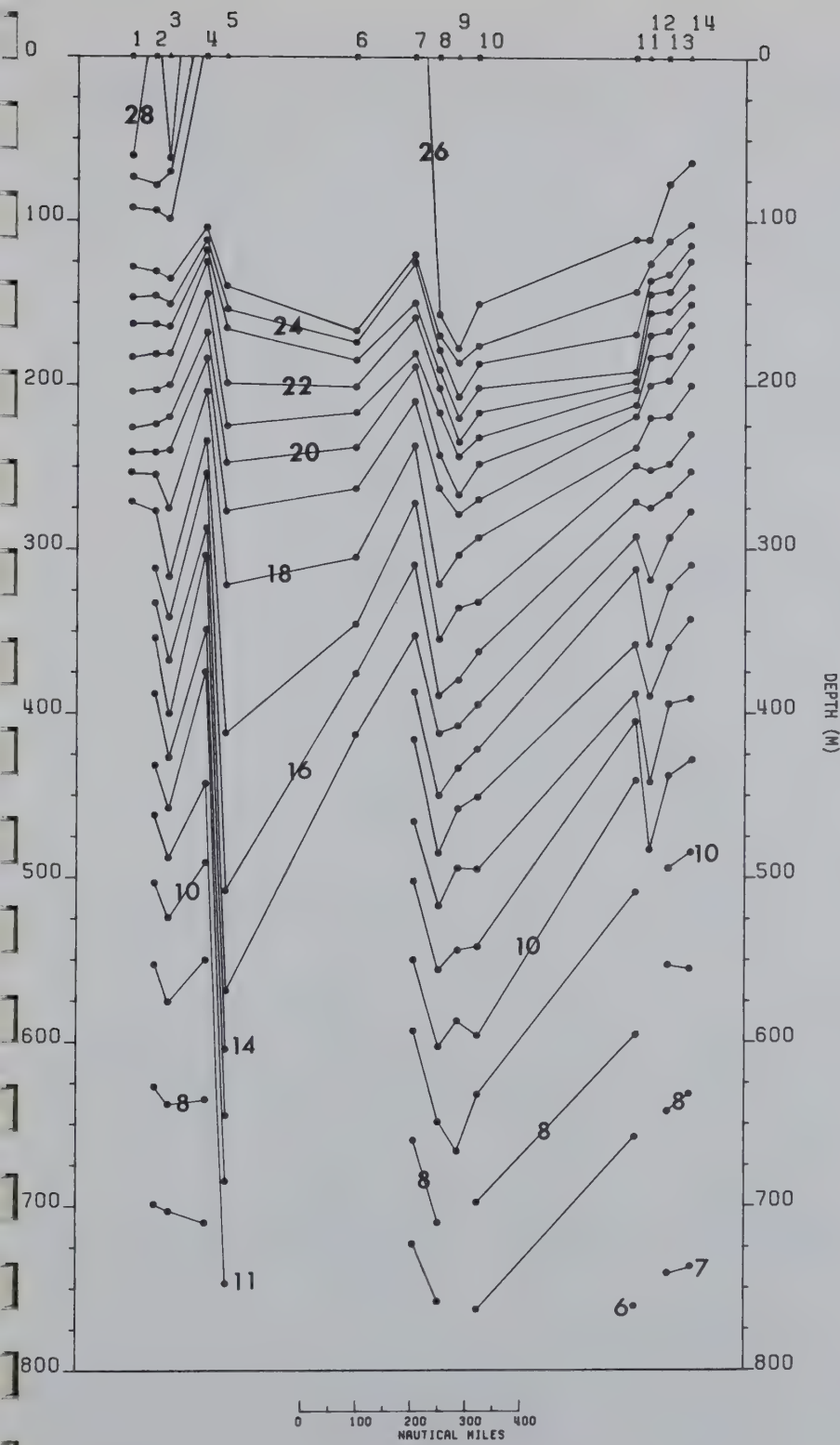
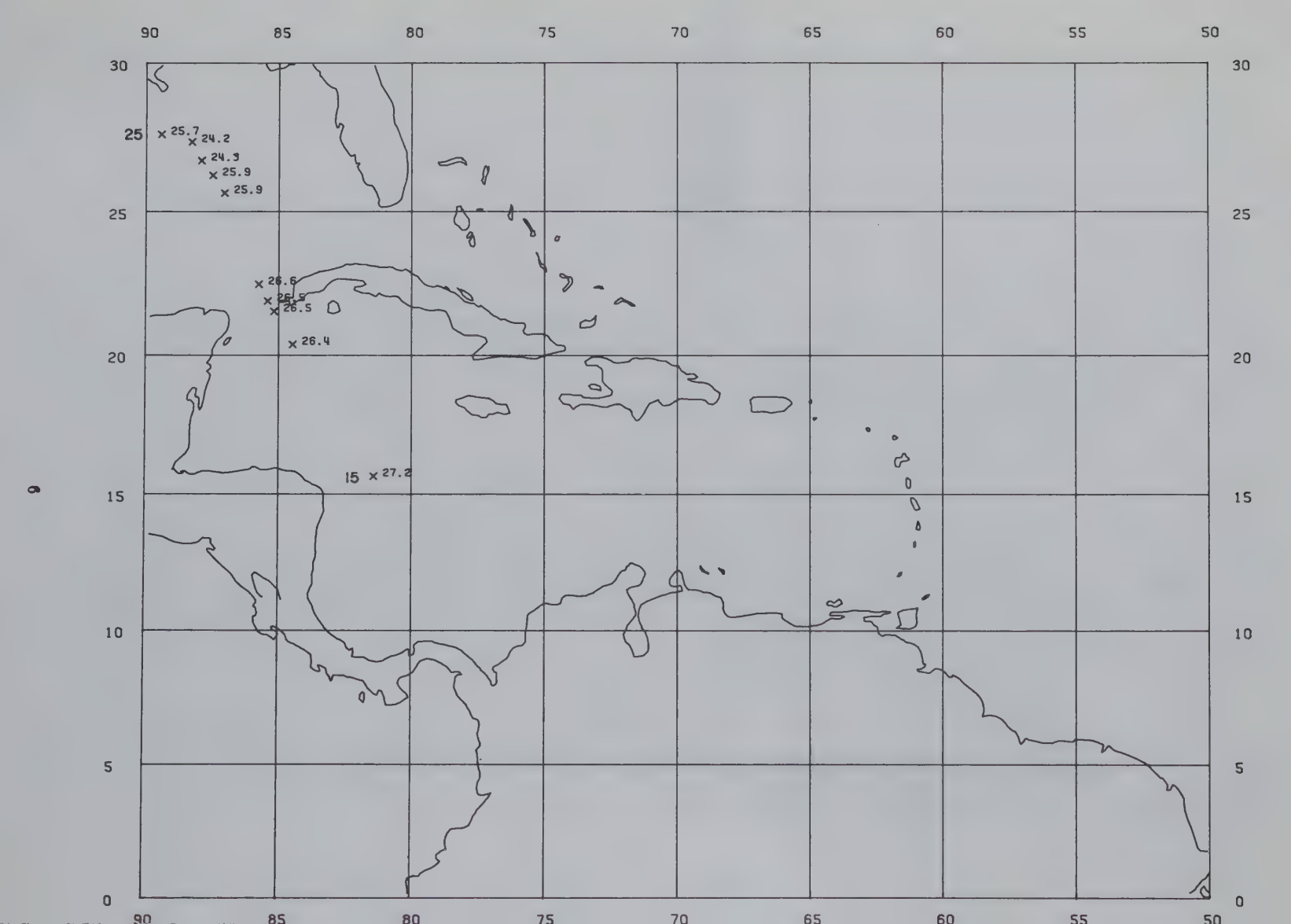


Figure 3.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 25-28 February 1972.


90
85
80
75
70
65
60
55
50
30
25
20
15
10
5
0
25.7
24.2
24.3
25.9
25.9
26.6
26.5
26.5
26.4
15
27.2

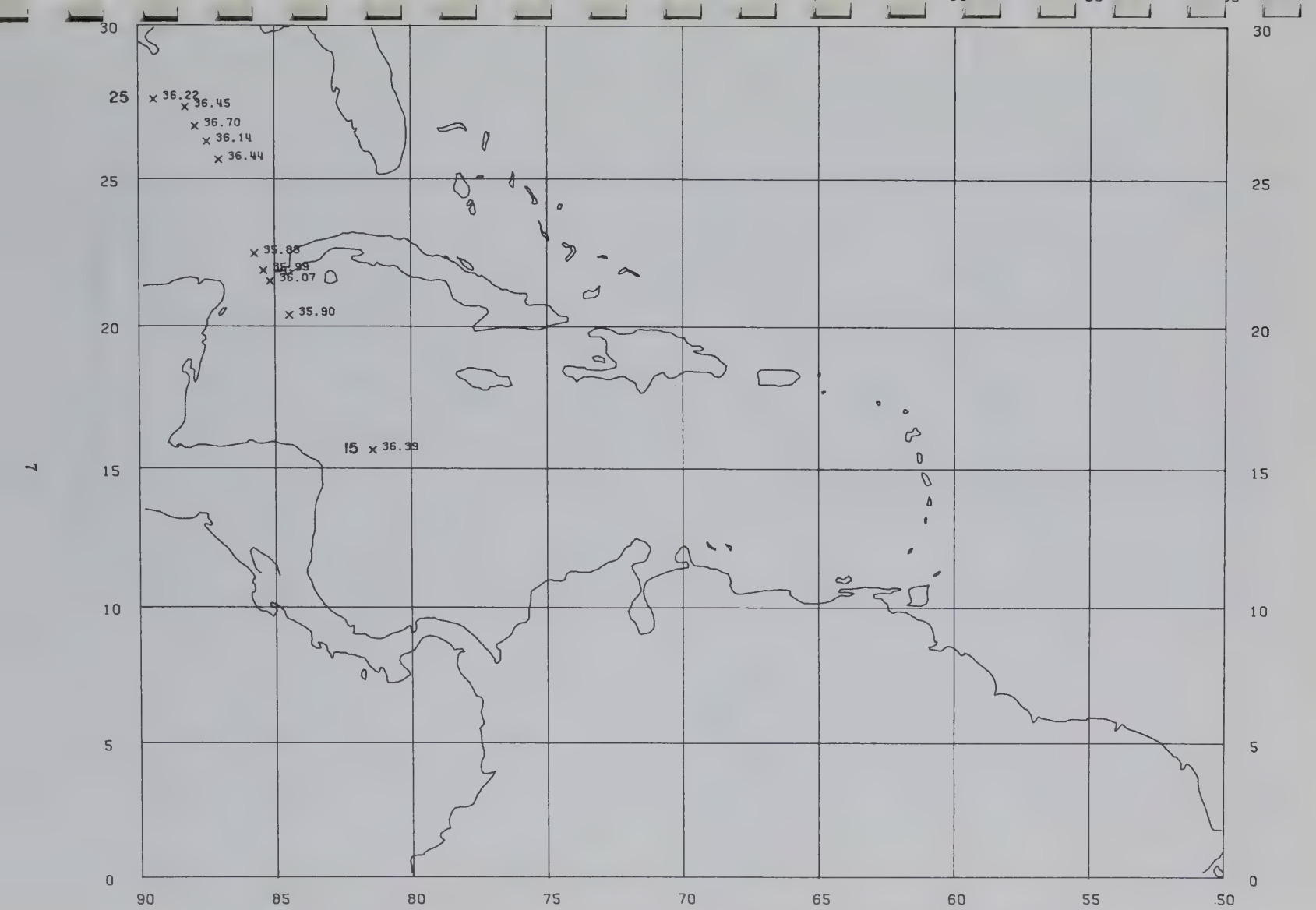


Figure 5.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper,* **26-28 March 1972.**

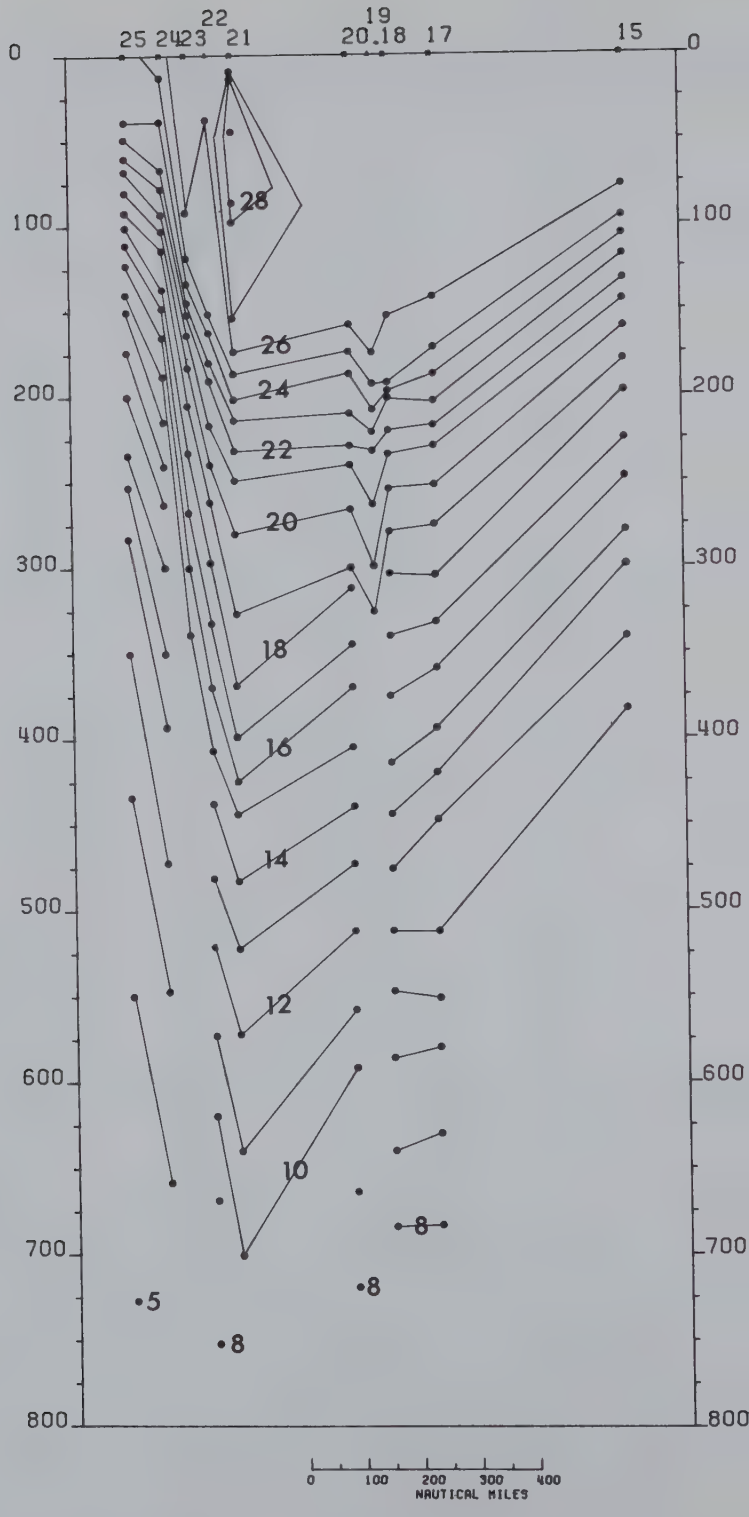


Figure 6.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 26-28 March 1972.

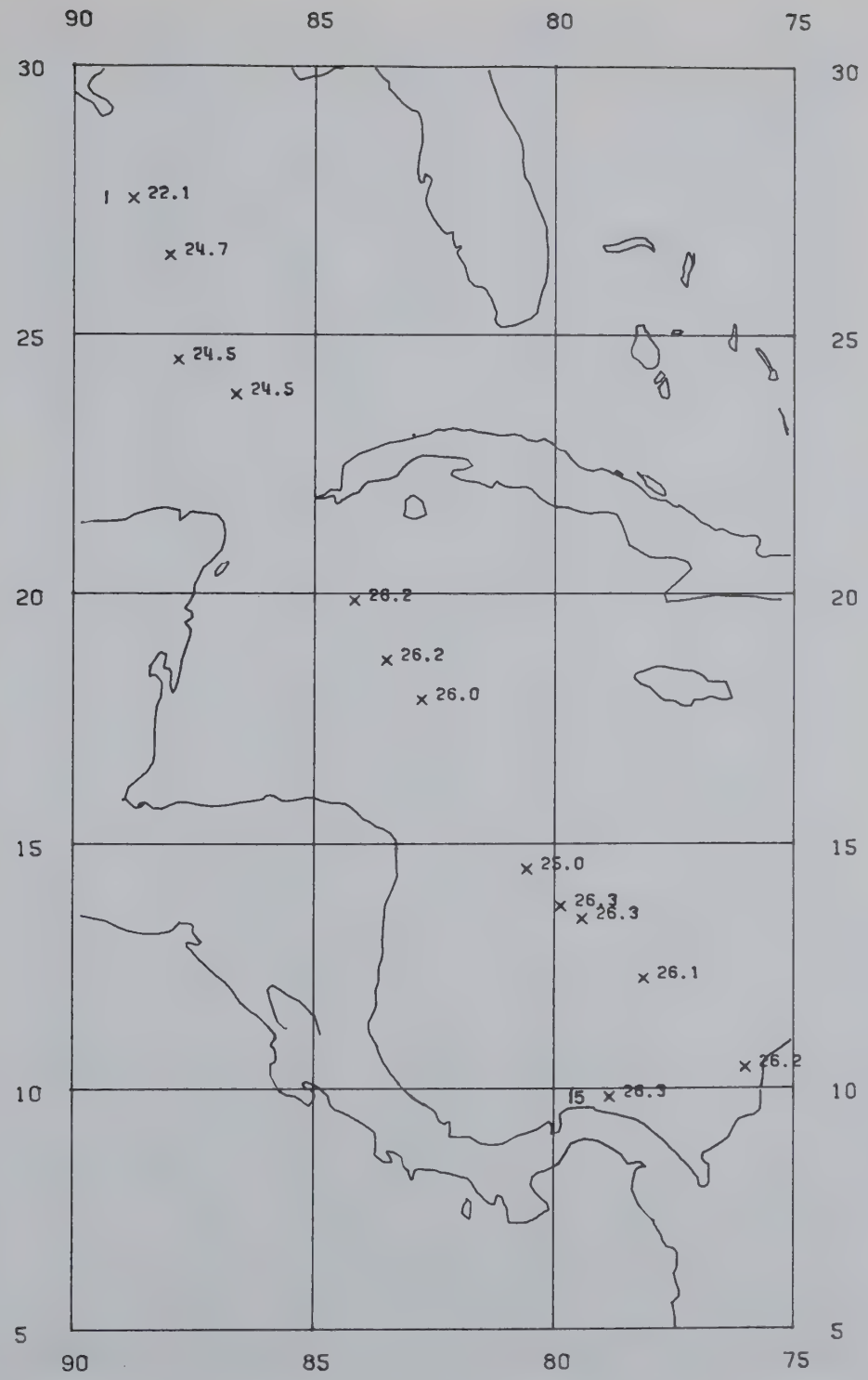


Figure 7.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **30 April-4 May 1972.**

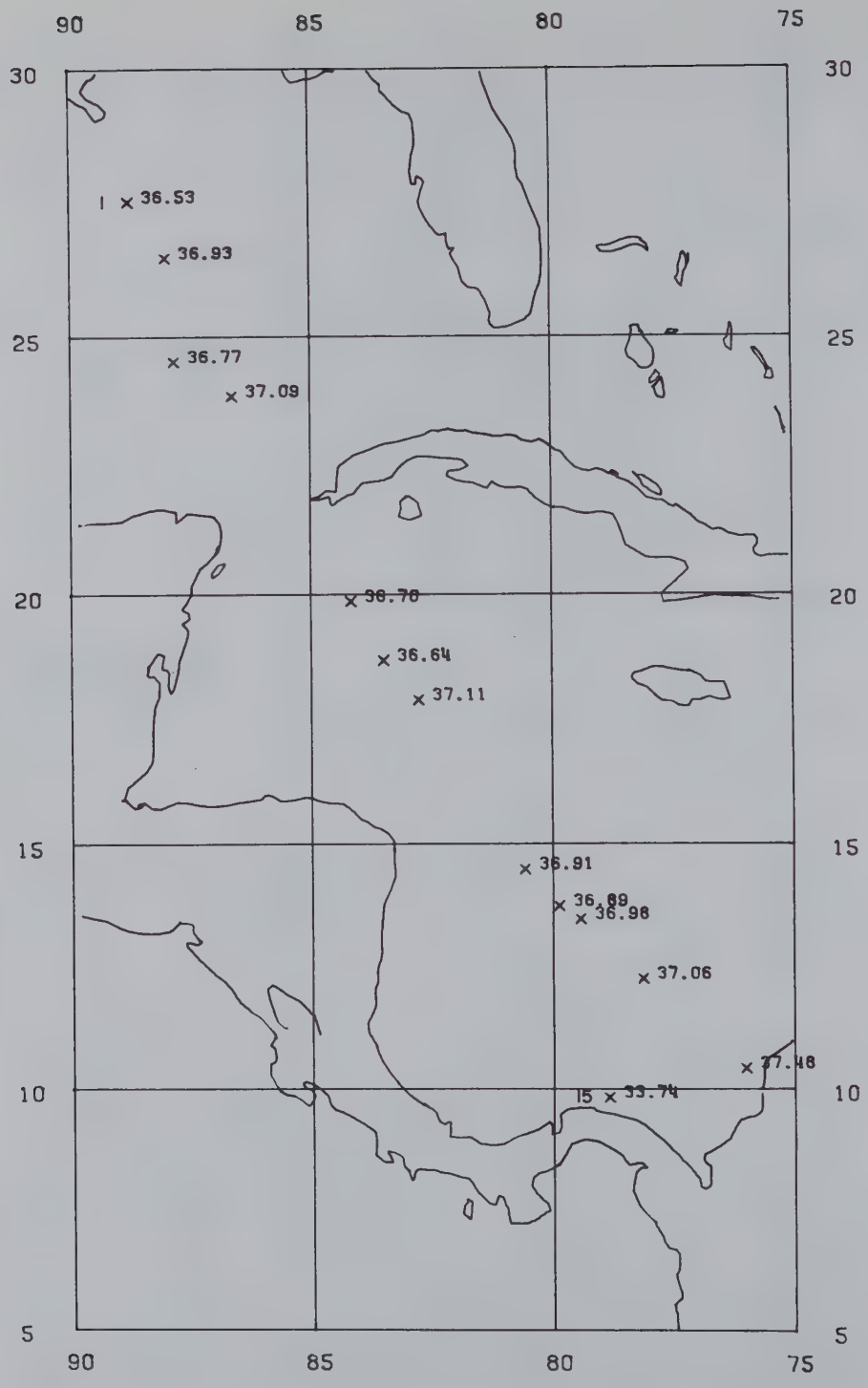


Figure 8.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **30 April-4 May 1972.**

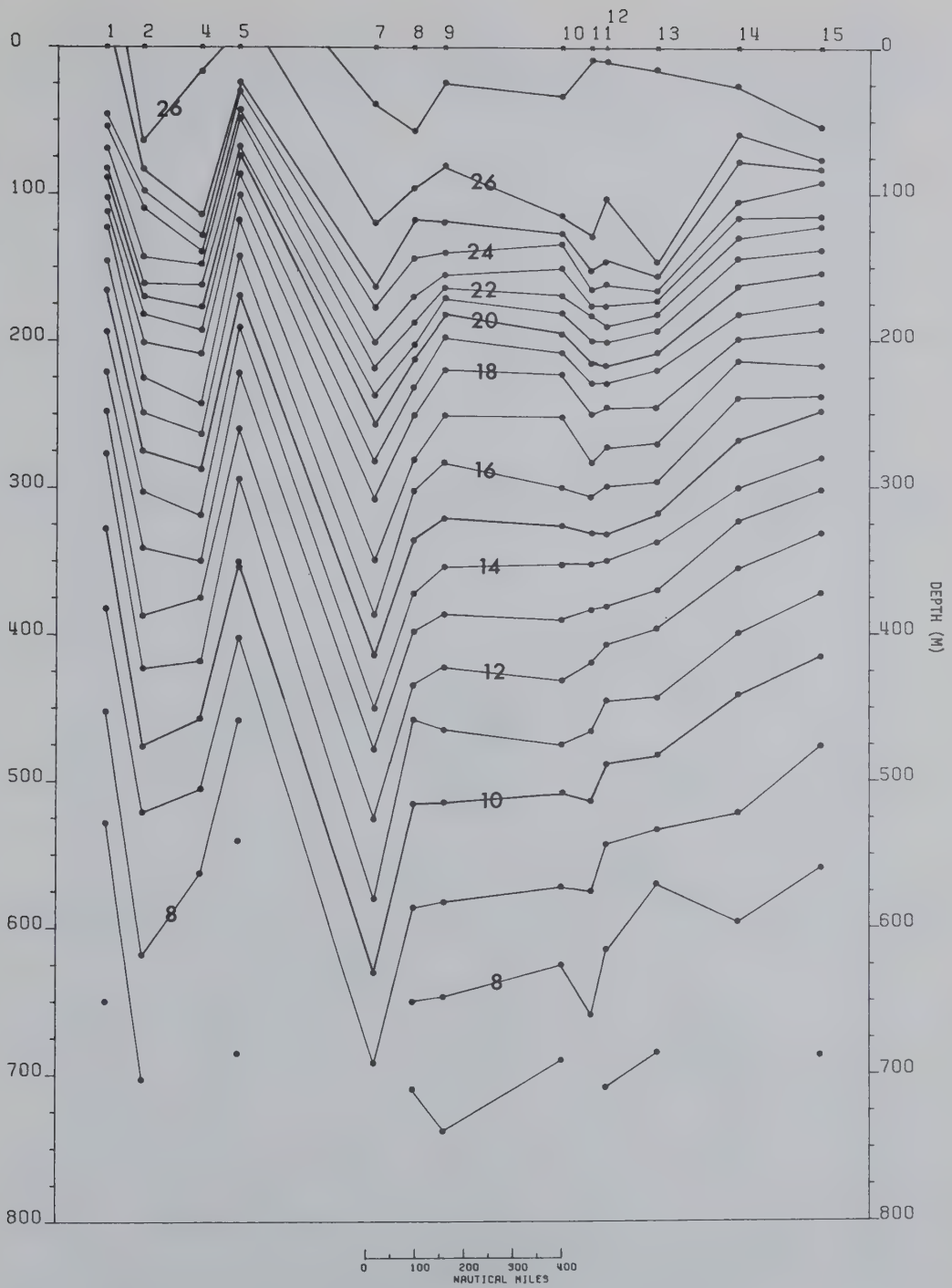


Figure 9.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, **30 April-4 May 1972.**

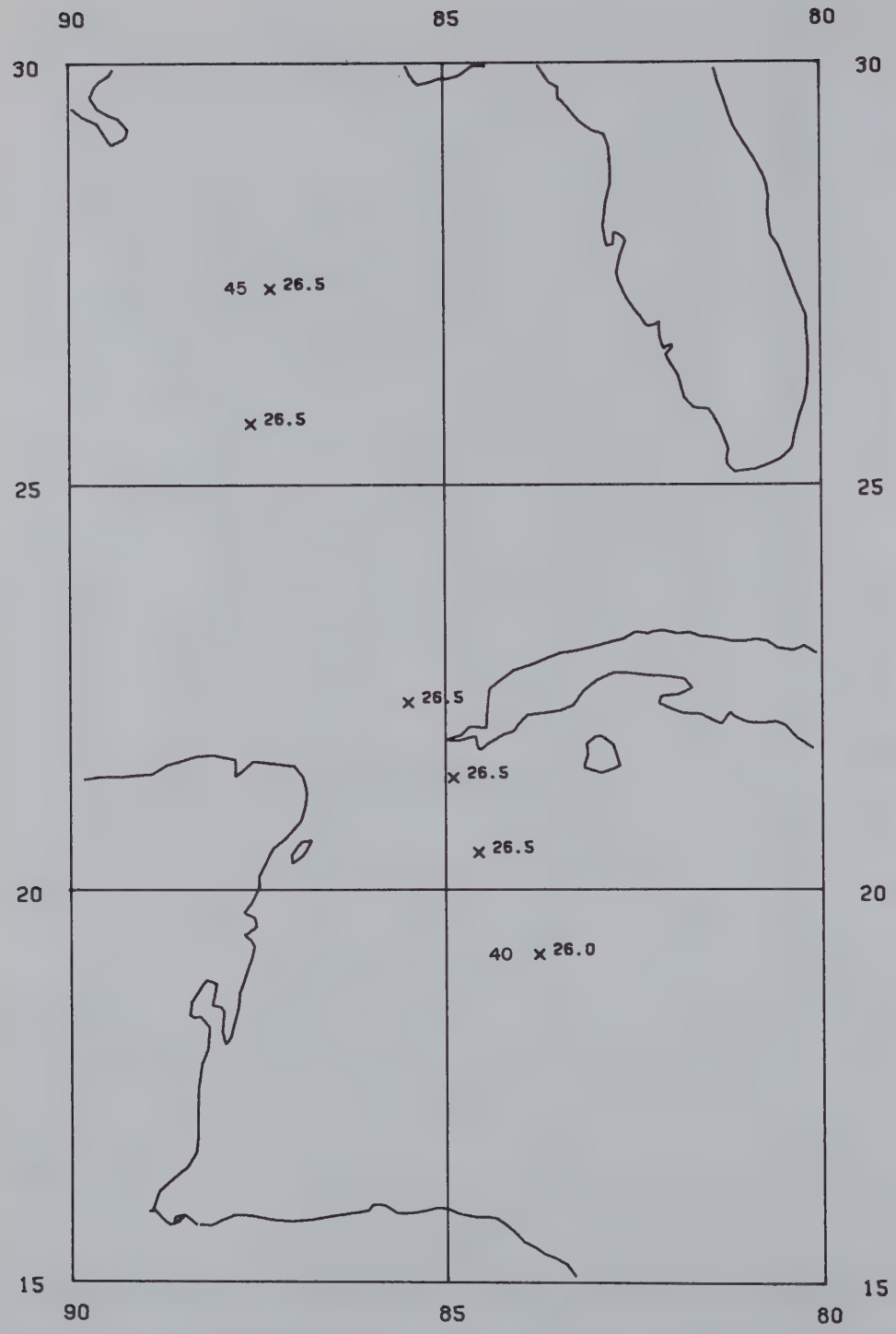


Figure 10.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **6-7 June 1972.**

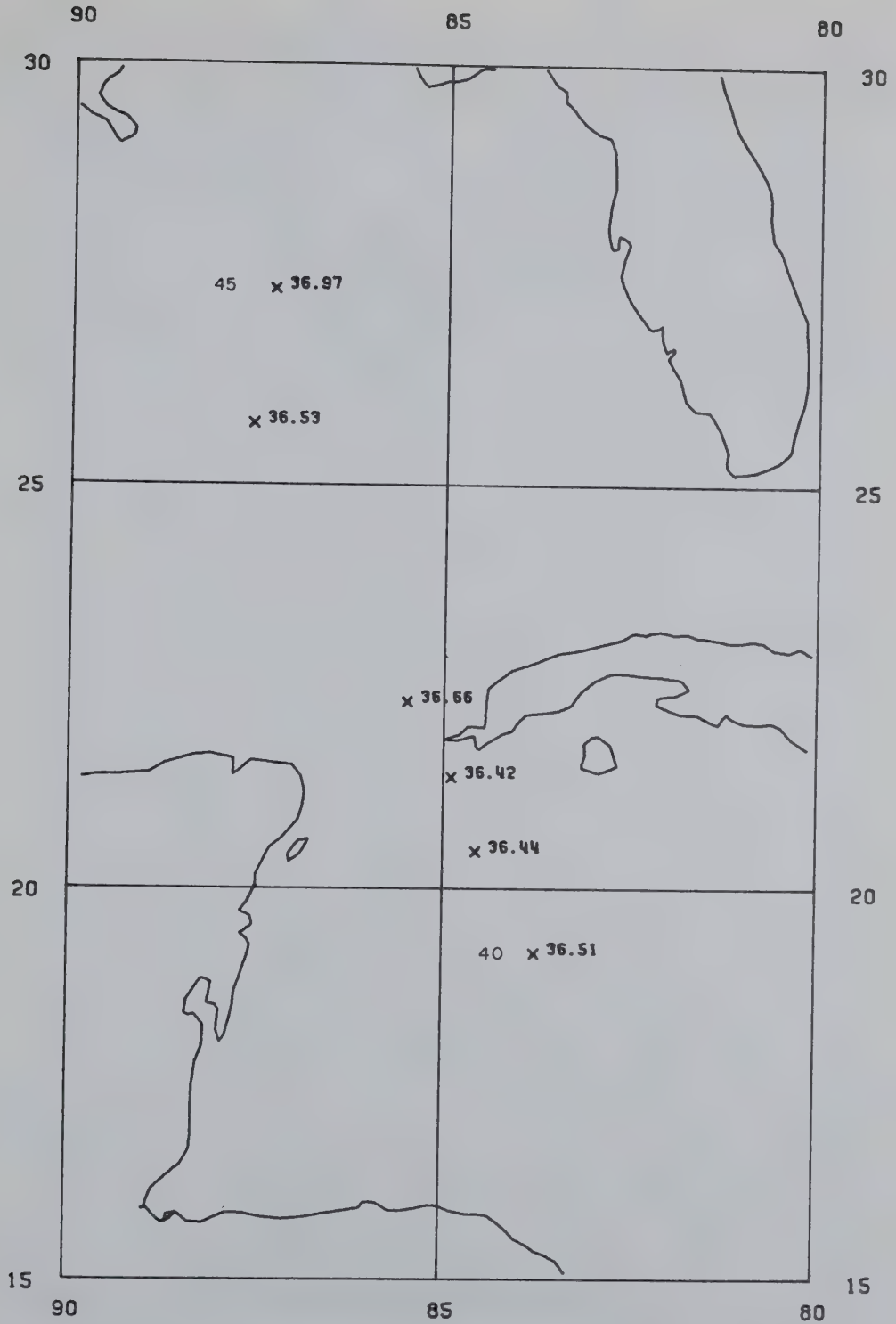


Figure 11.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **6-7 June 1972.**

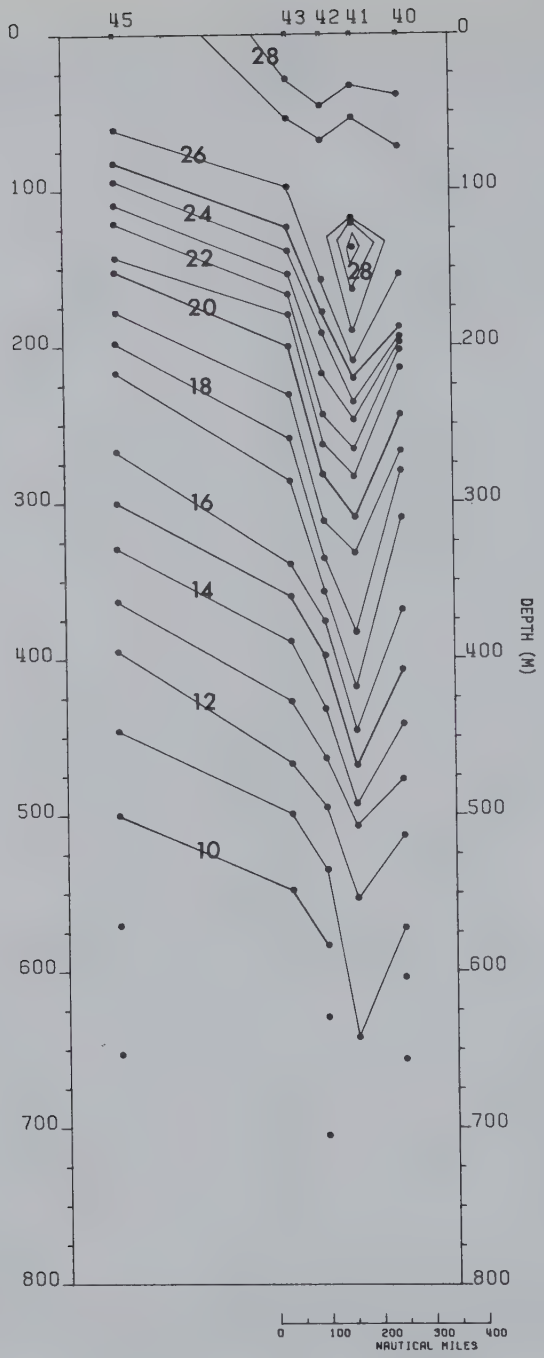


Figure 12.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 6-7 June 1972.

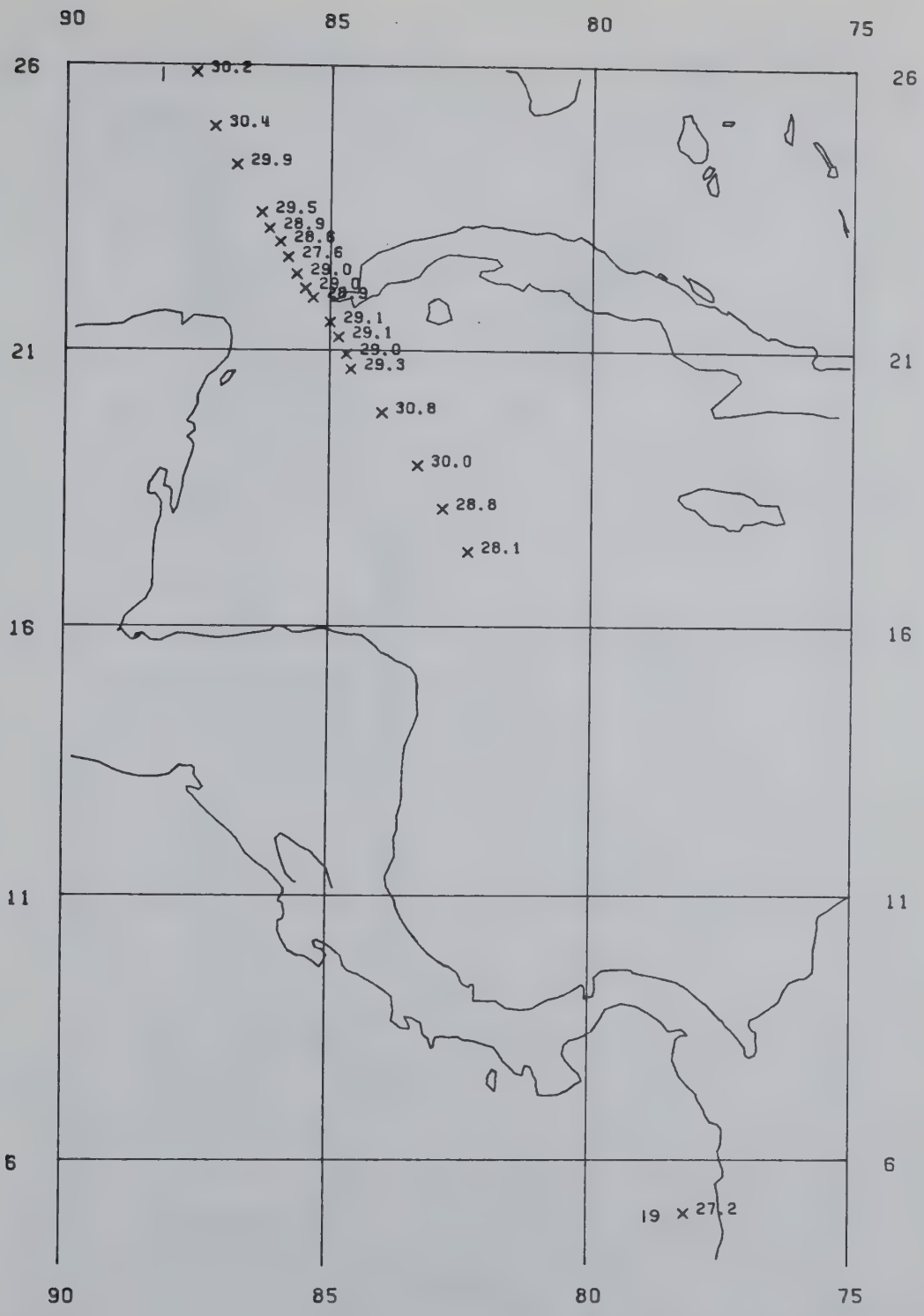


Figure 13.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **21-28 August 1972.**

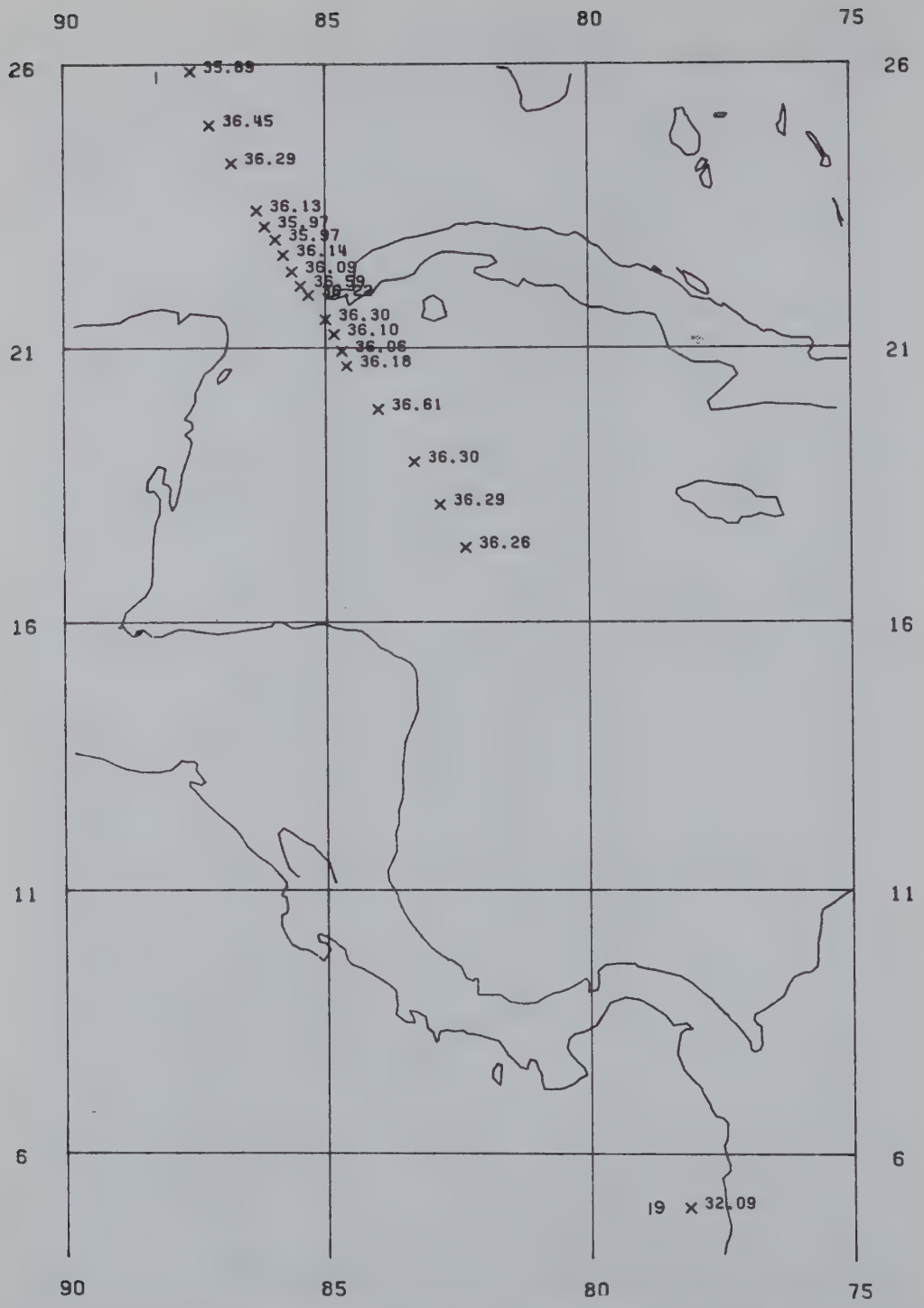


Figure 14.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, 21-28 August 1972.

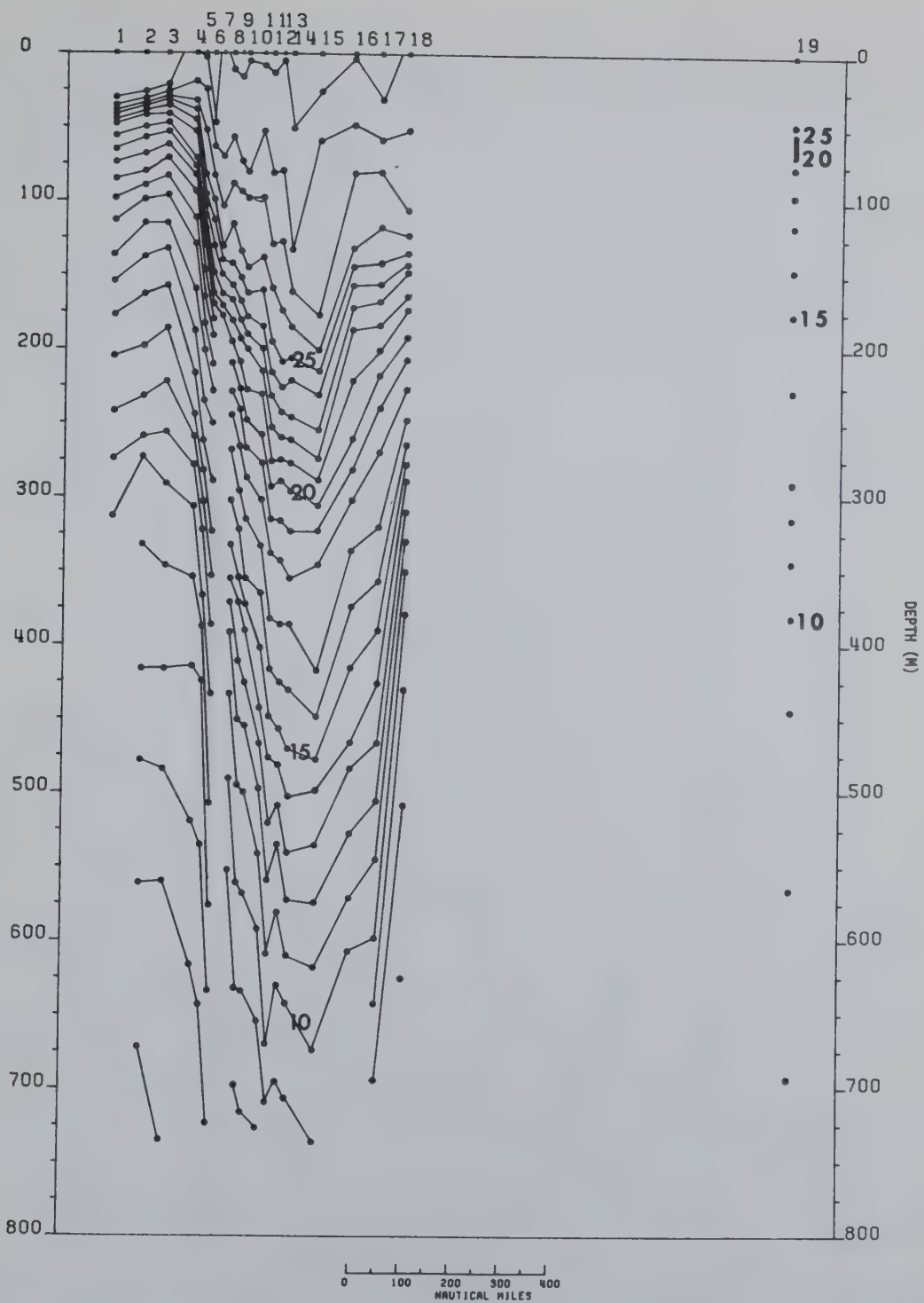


Figure 15.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 21-28 August 1972.

Figure 16.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Delta Argentina*, **14-18 November 1972.**

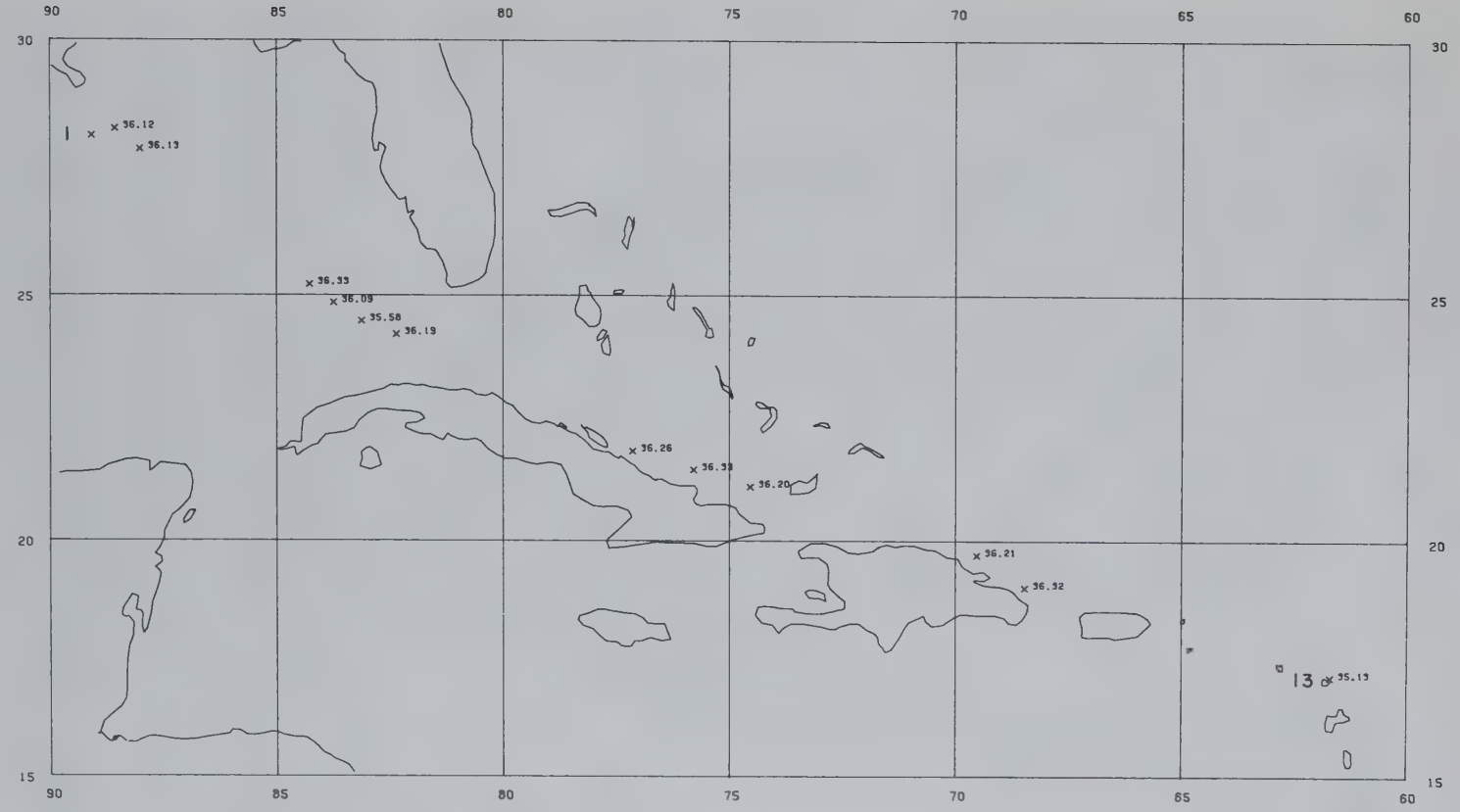


Figure 17.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Delta Argentina*, **14-18 November 1972.**

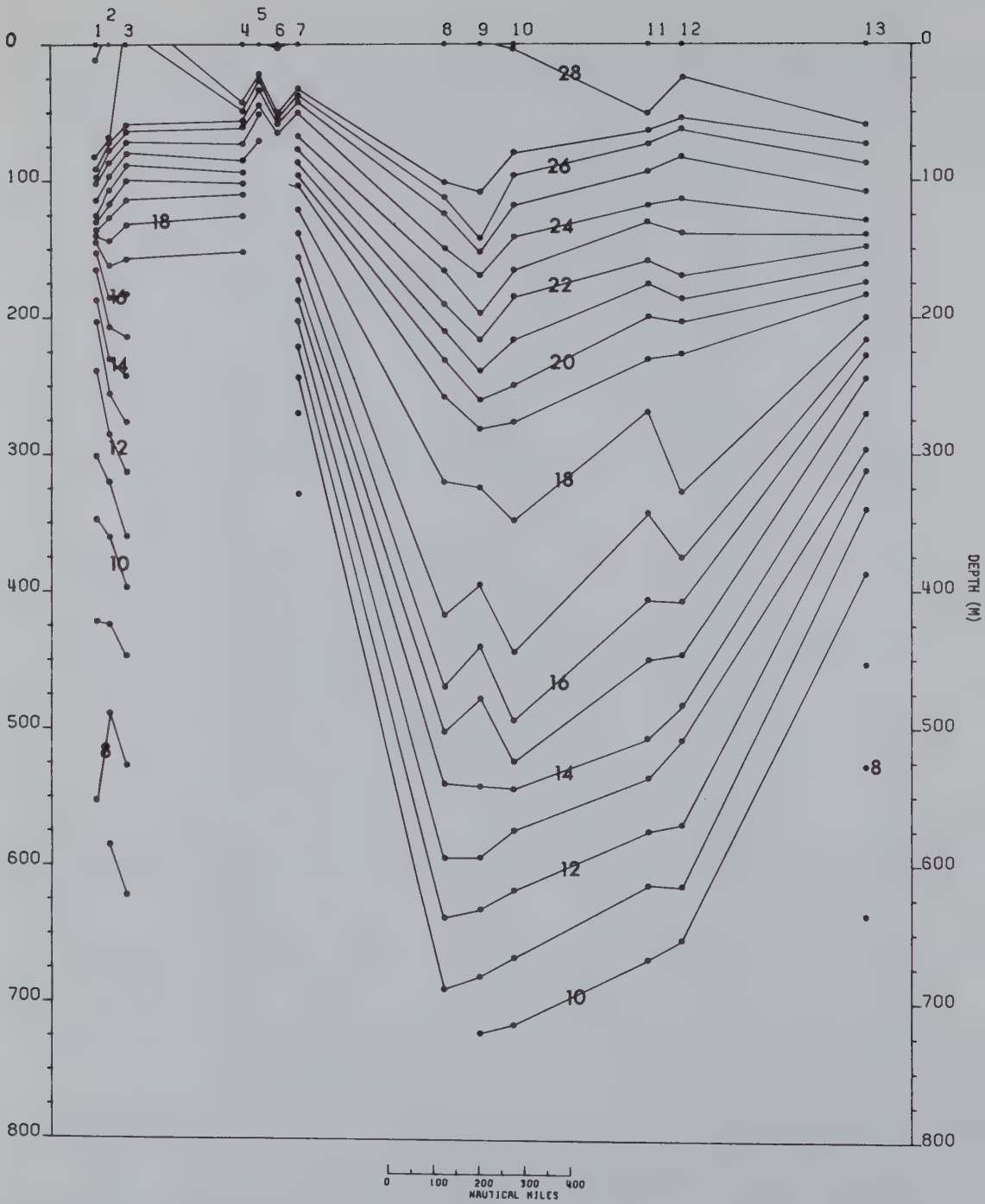


Figure 18.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Delta Argentina*, 14-18 November 1972.

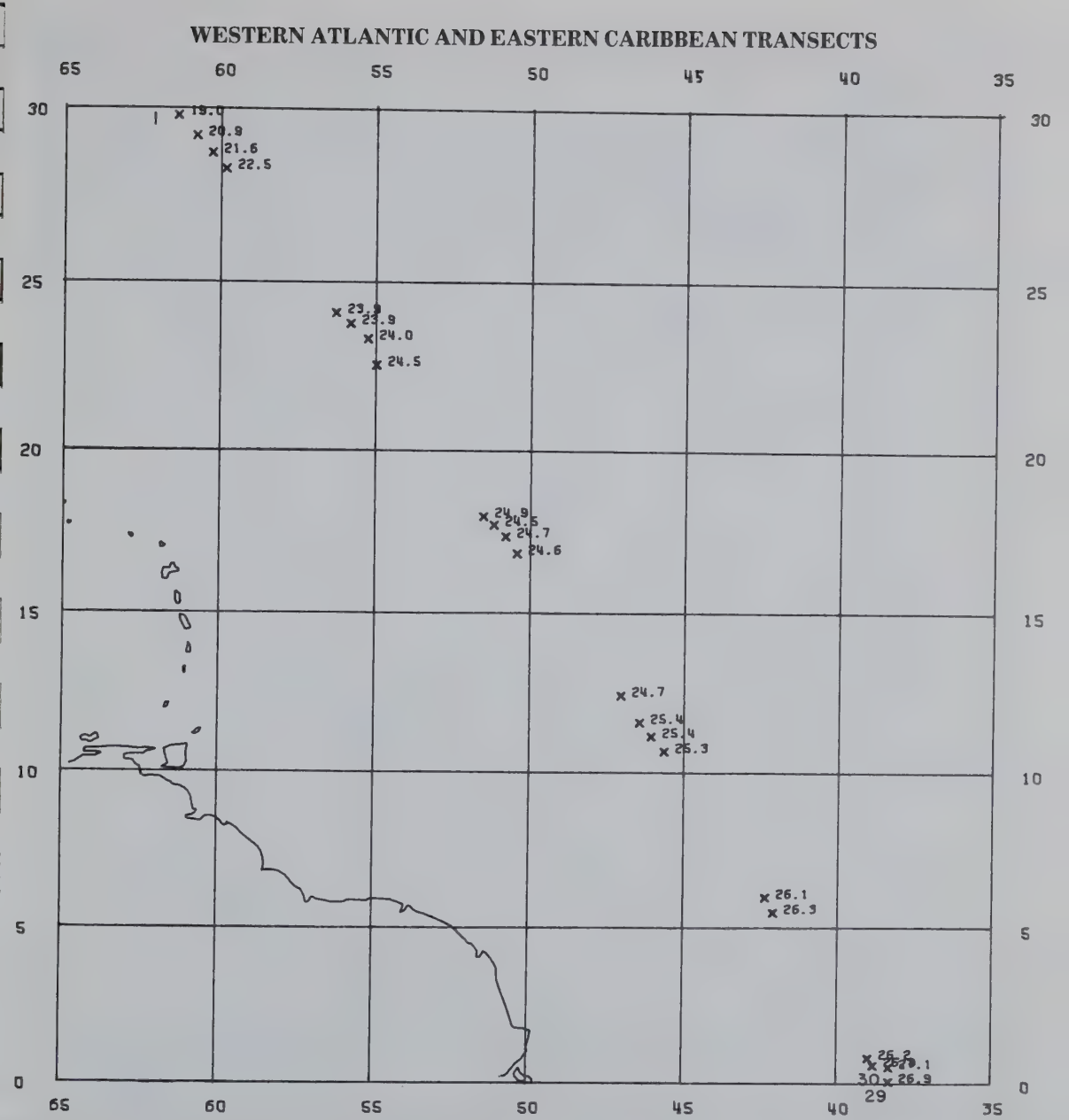


Figure 19.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Trade*, 27 January-1 February 1972.

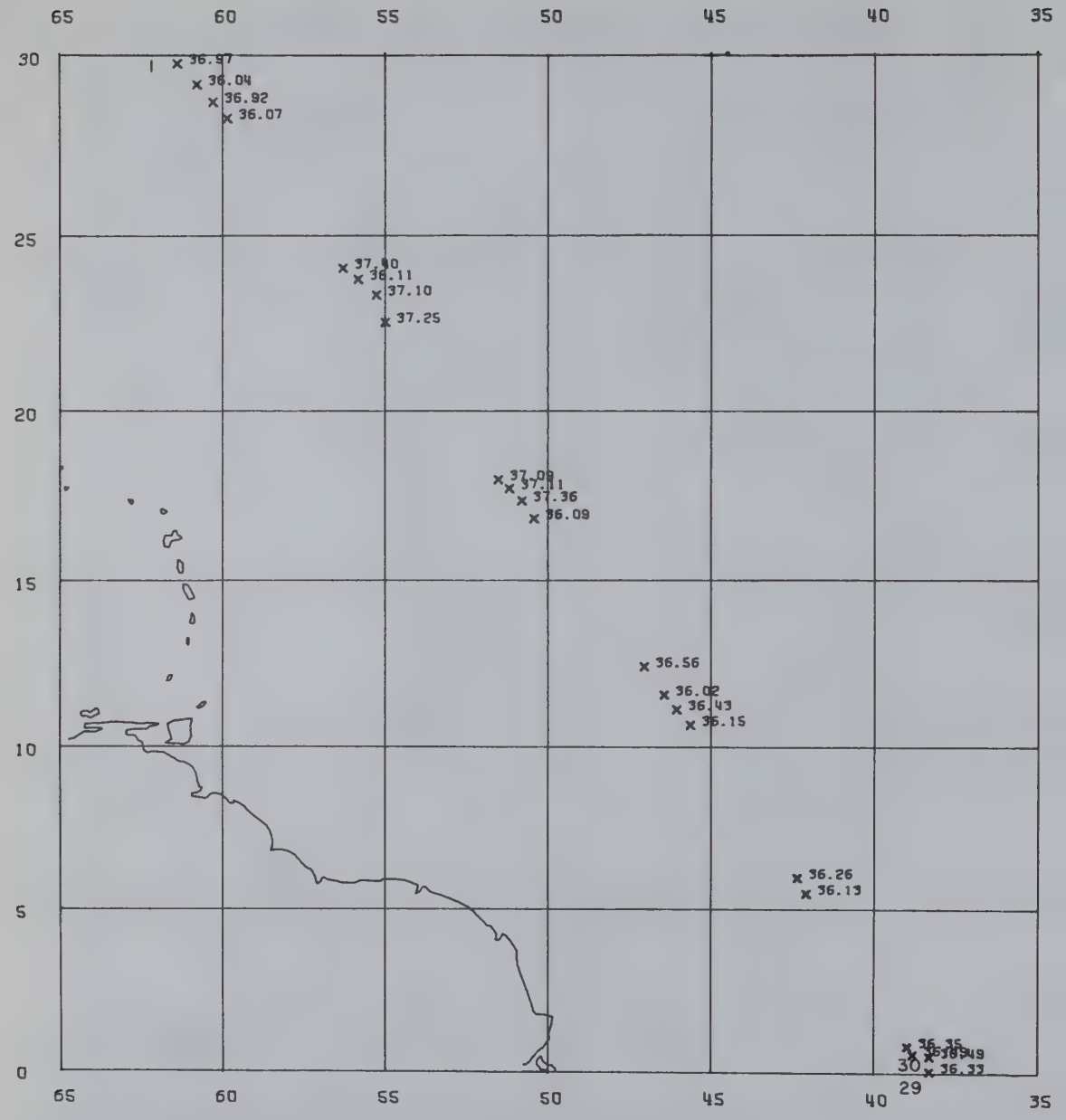


Figure 20.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Mormac Trade*, 27 January - 1 February 1972.

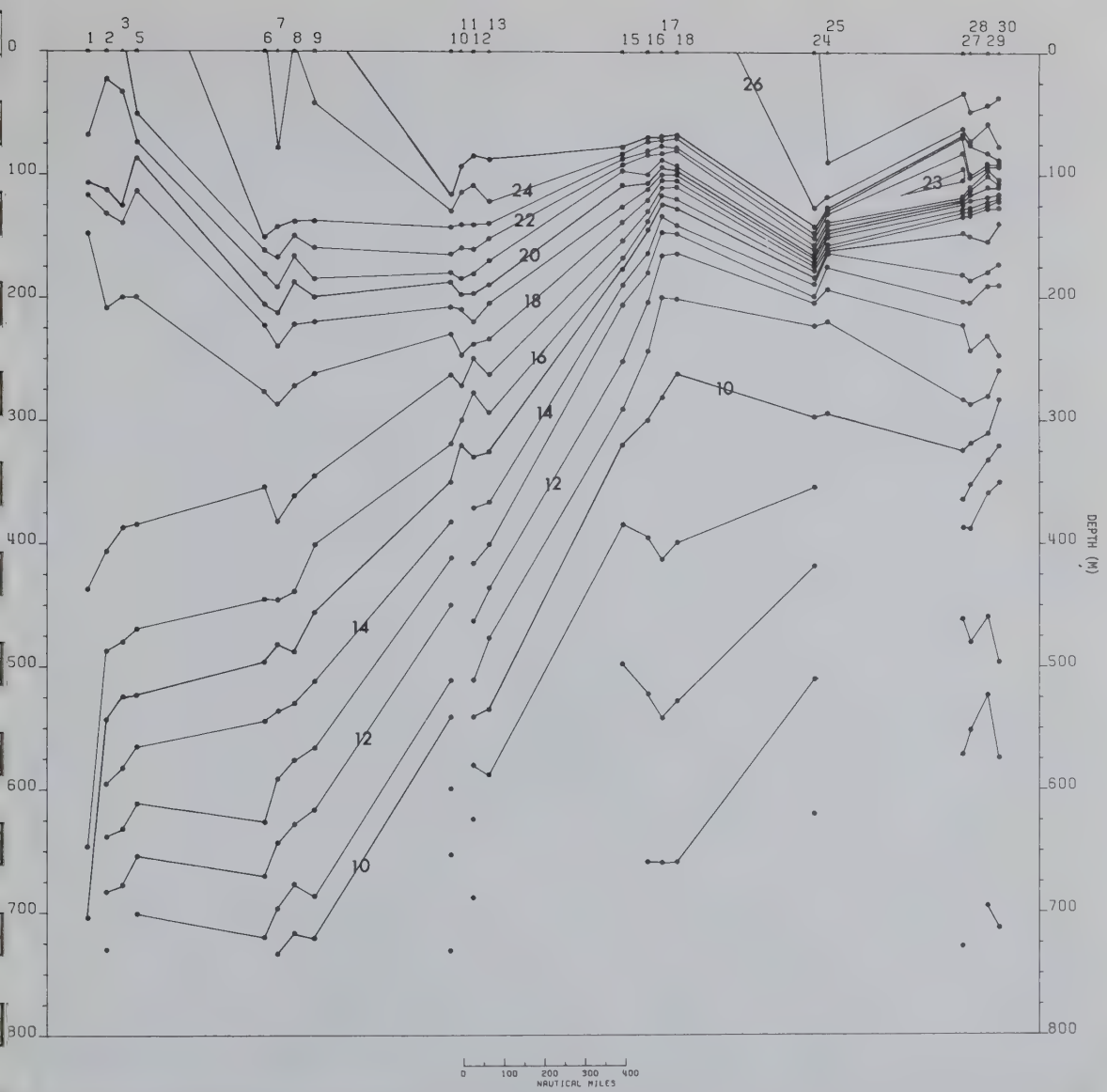


Figure 21.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Trade*, **27 January-1 February 1972.**

Figure 22.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Bay State*, **10-14 February 1972.**

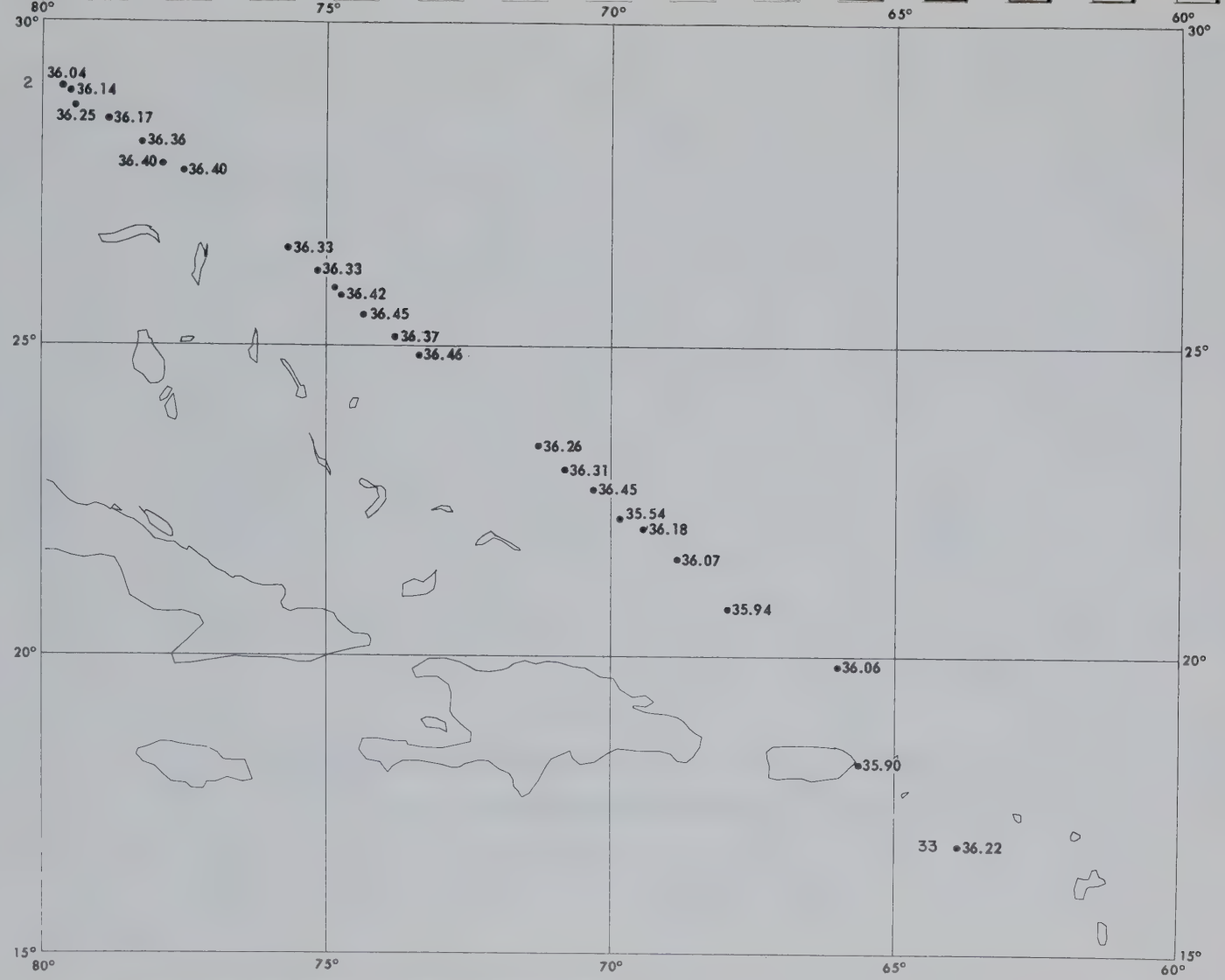


Figure 23.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Bay State*, 10-14 February 1972.

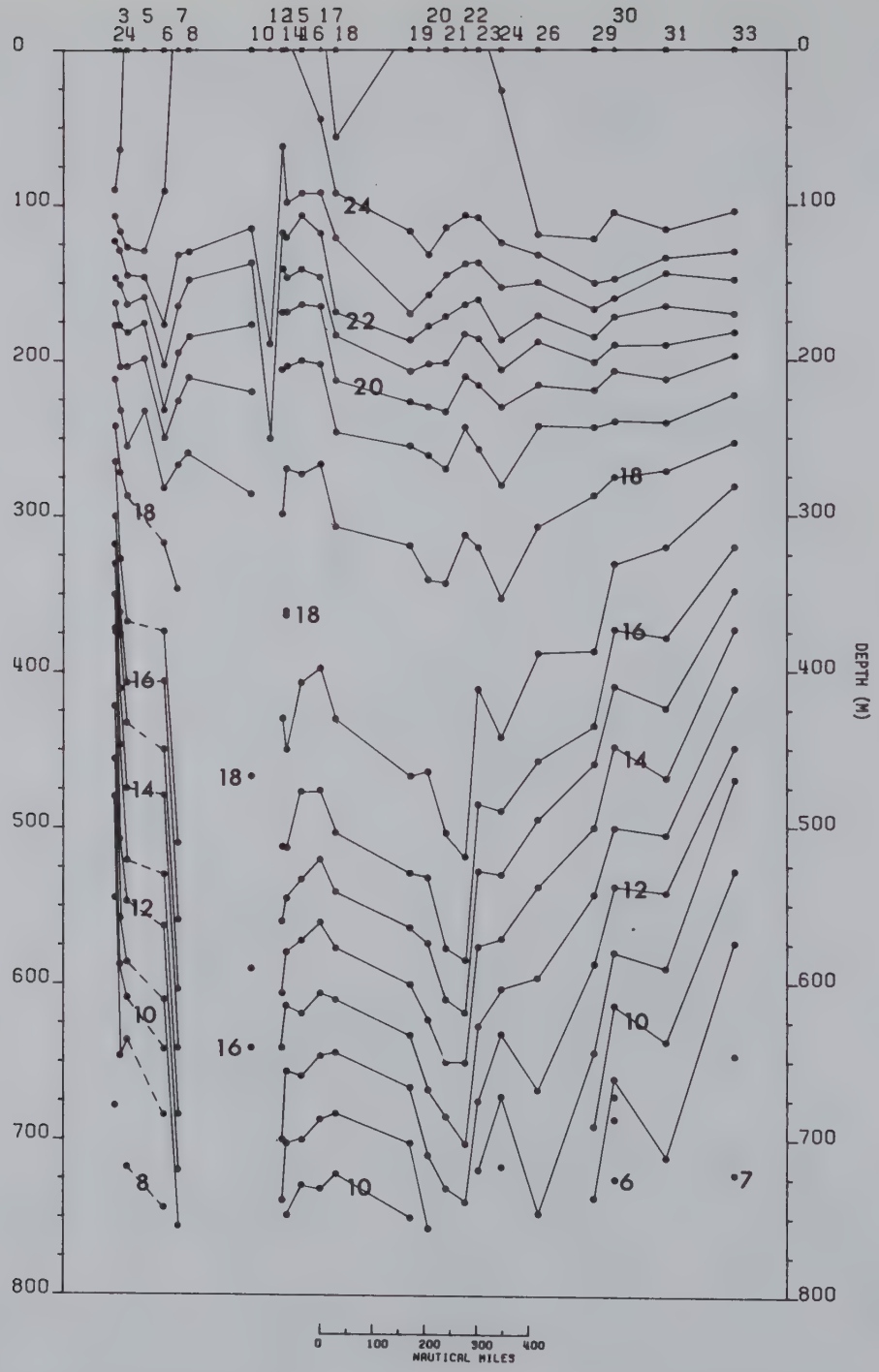


Figure 24.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Bay State*, 10-14 February 1972.

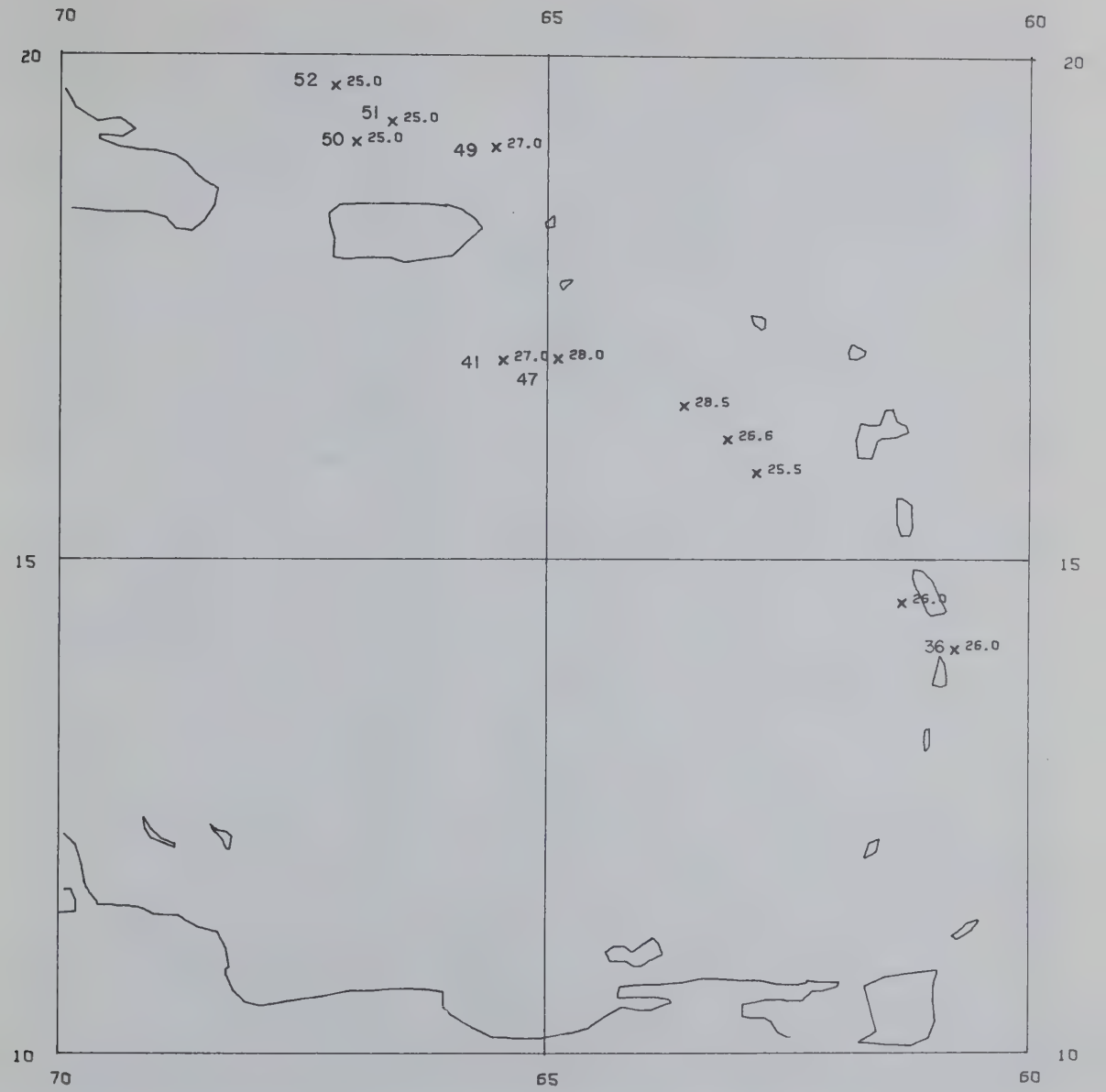


Figure 25.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Bay State*, **19-23 February 1972.**

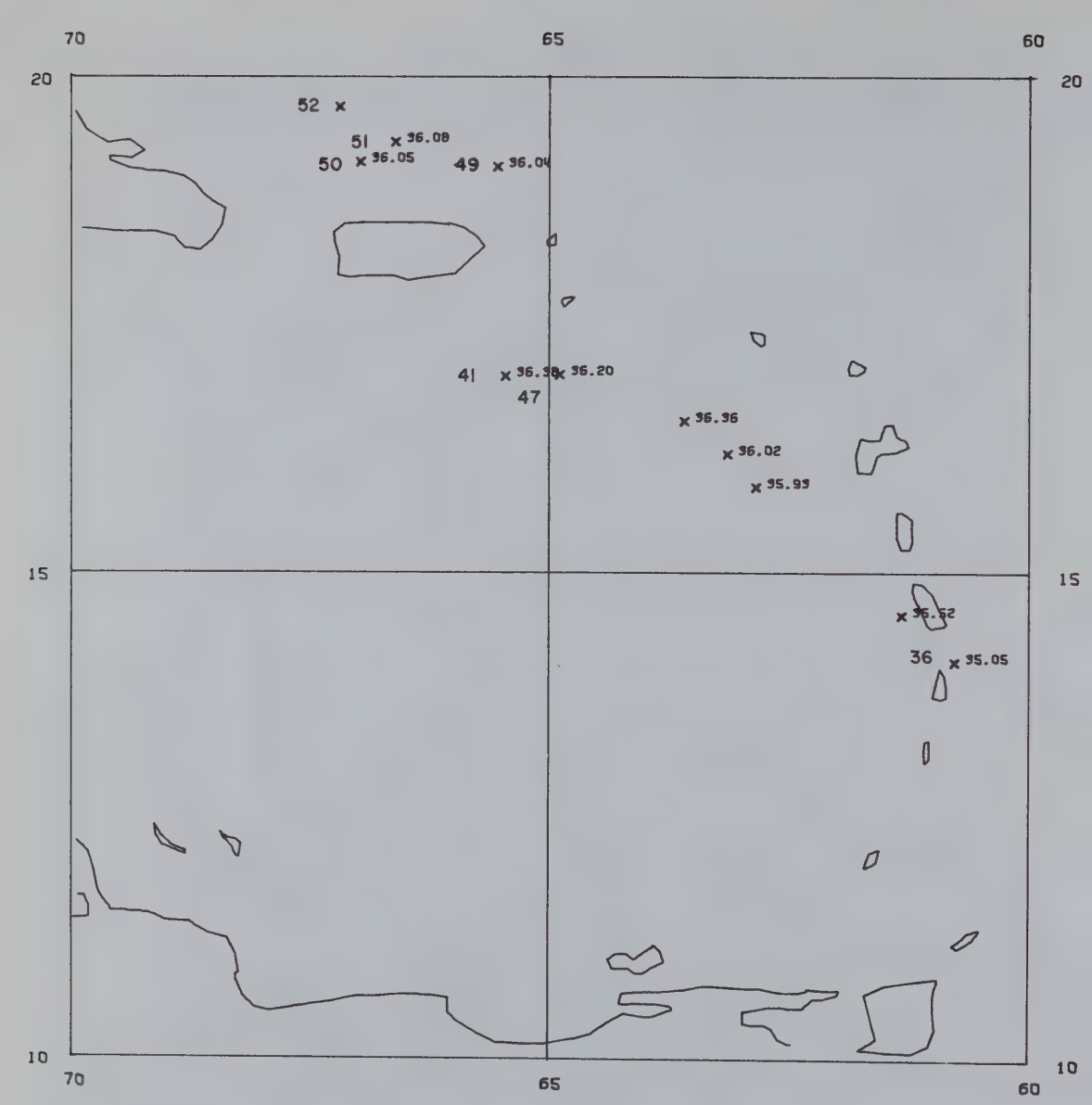


Figure 26.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Bay State.* **19-23 February 1972.**

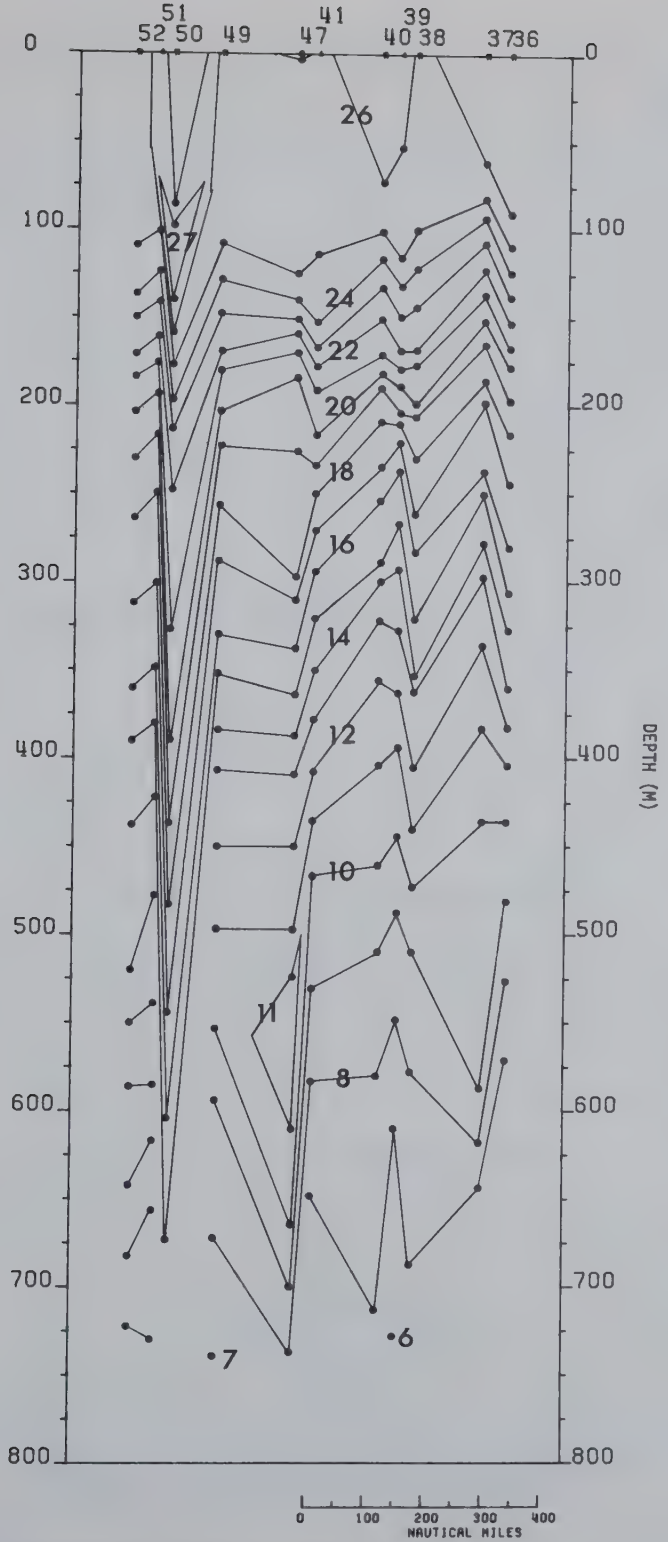


Figure 27.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Bay State*, 19-23 February 1972.

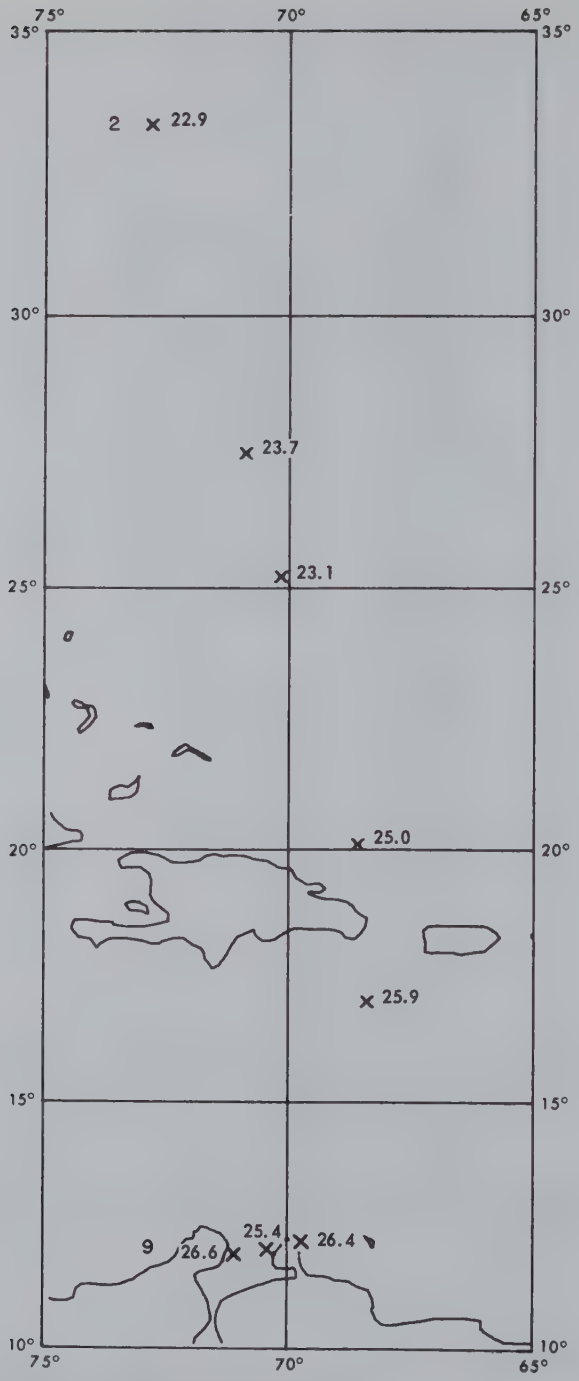


Figure 28.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz.* **13-25 March 1972.**

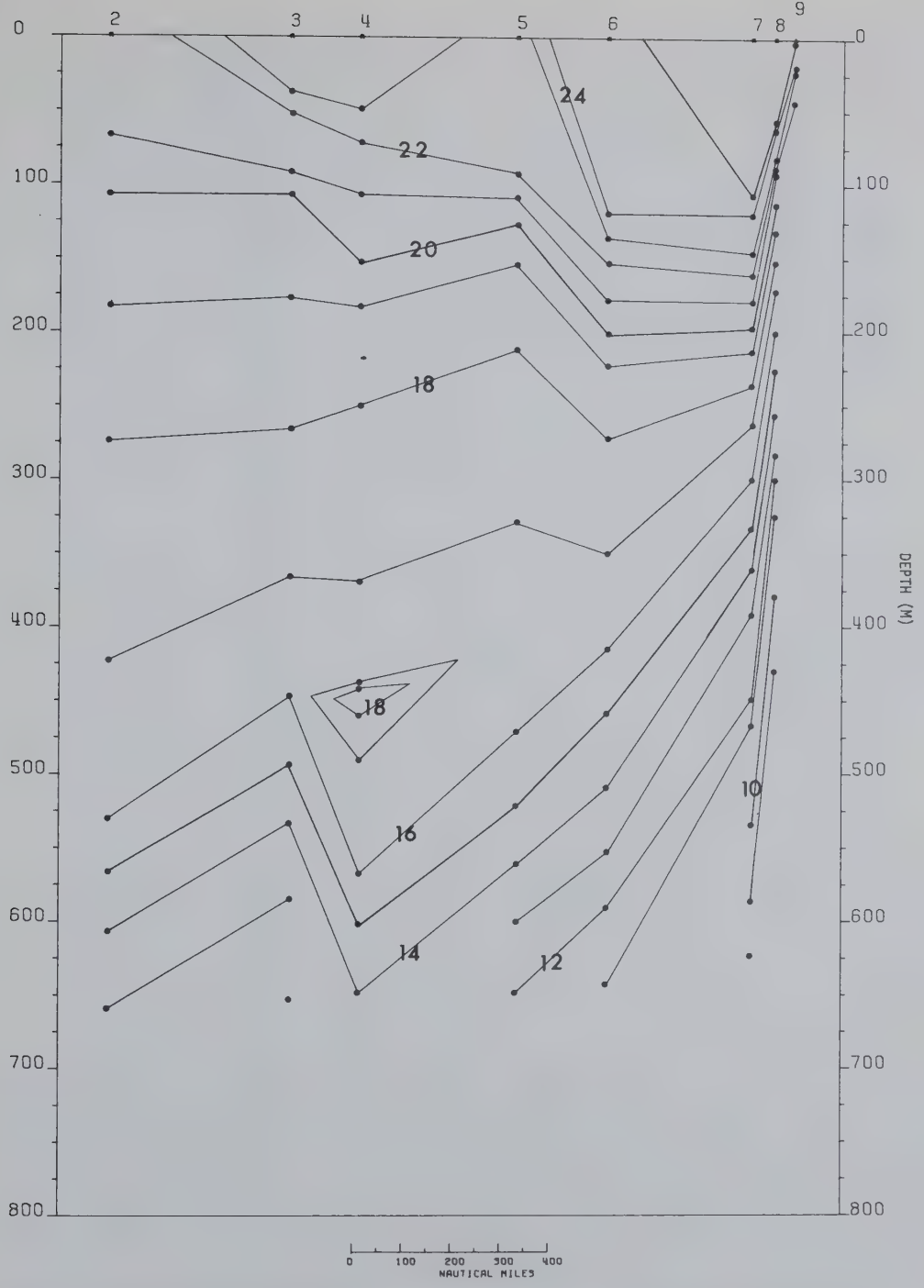


Figure 29.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **13-25 March 1972.**

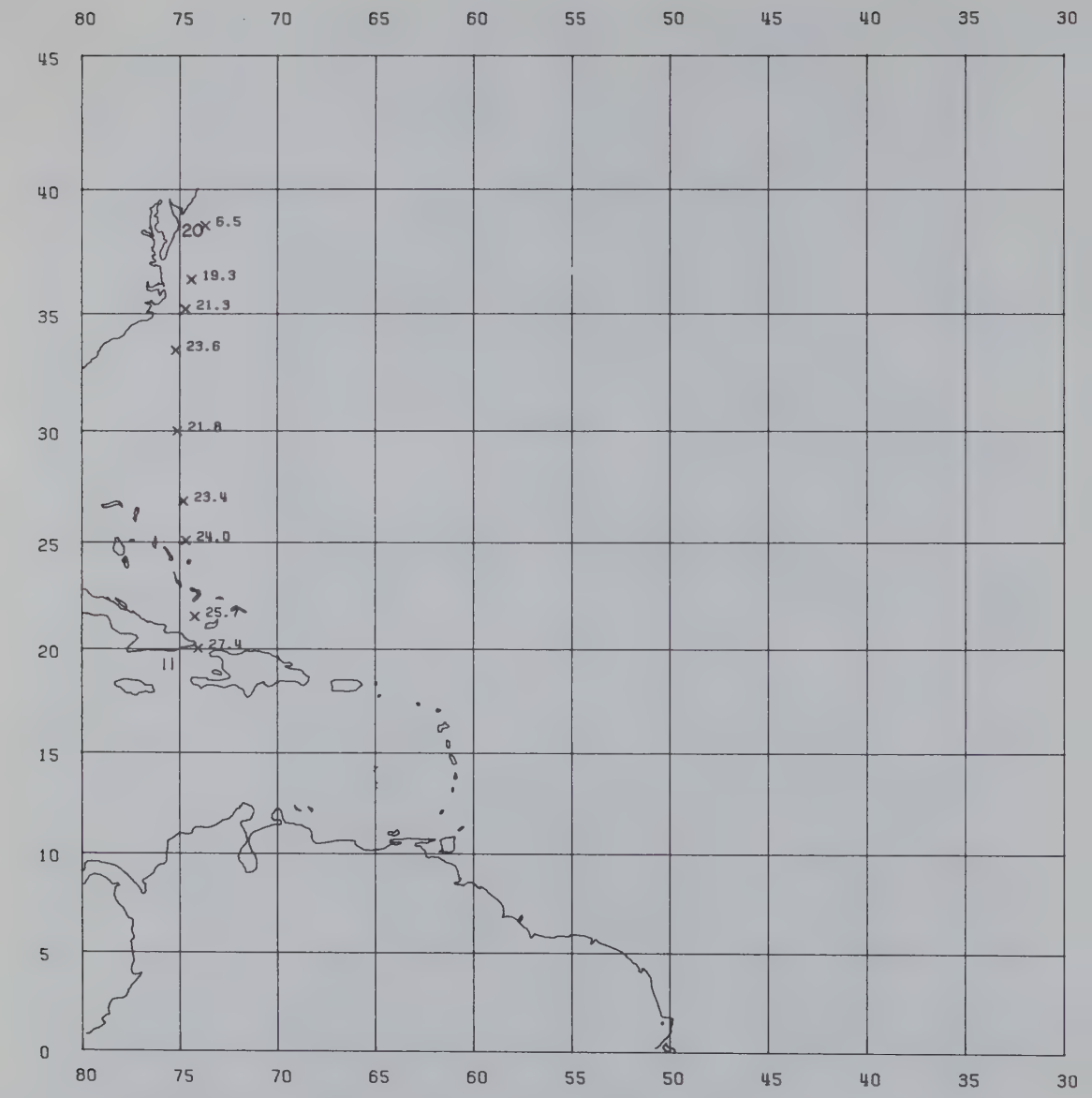


Figure 30.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **26-29 March 1972.**

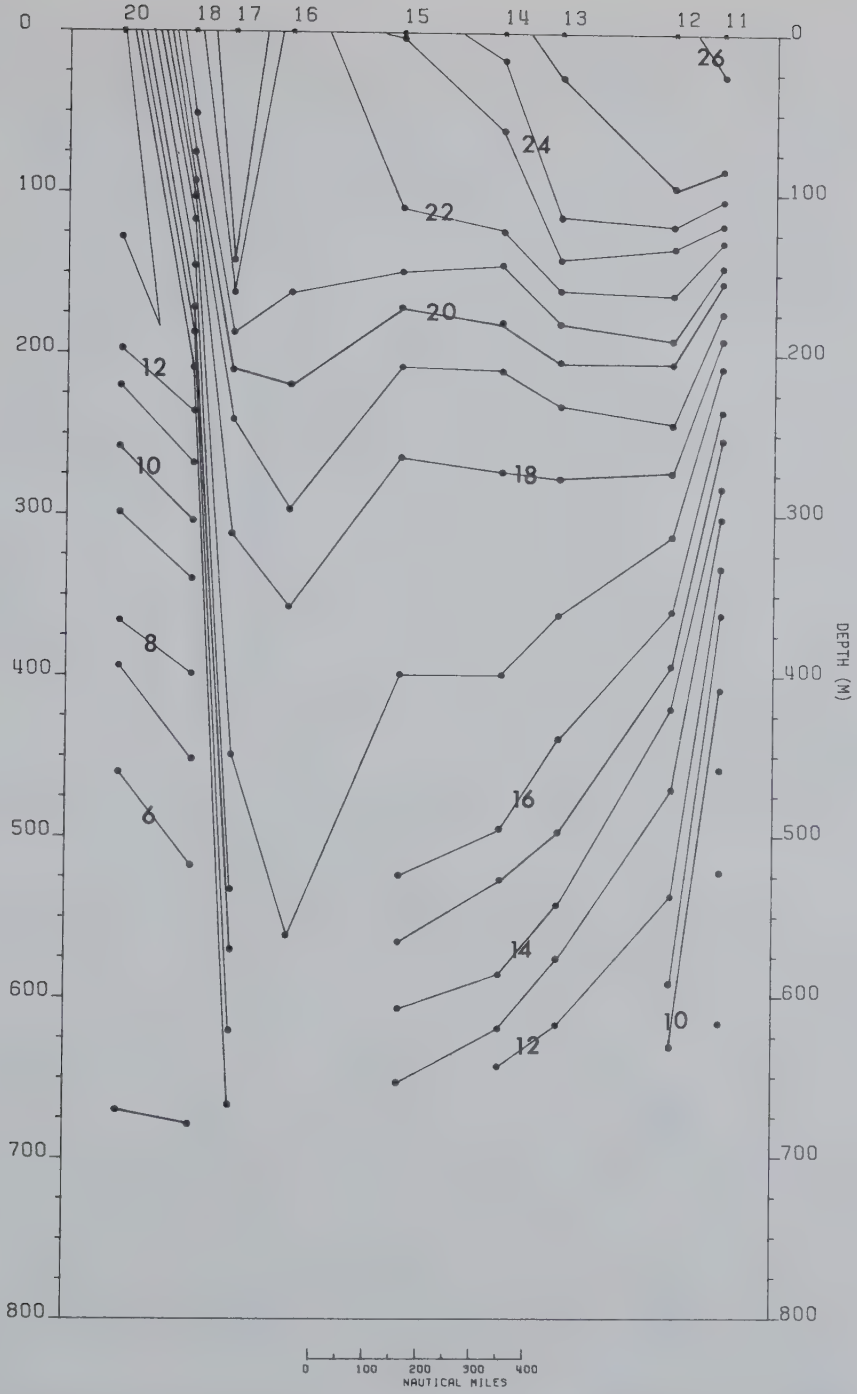


Figure 31.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **26-29 March 1972.**

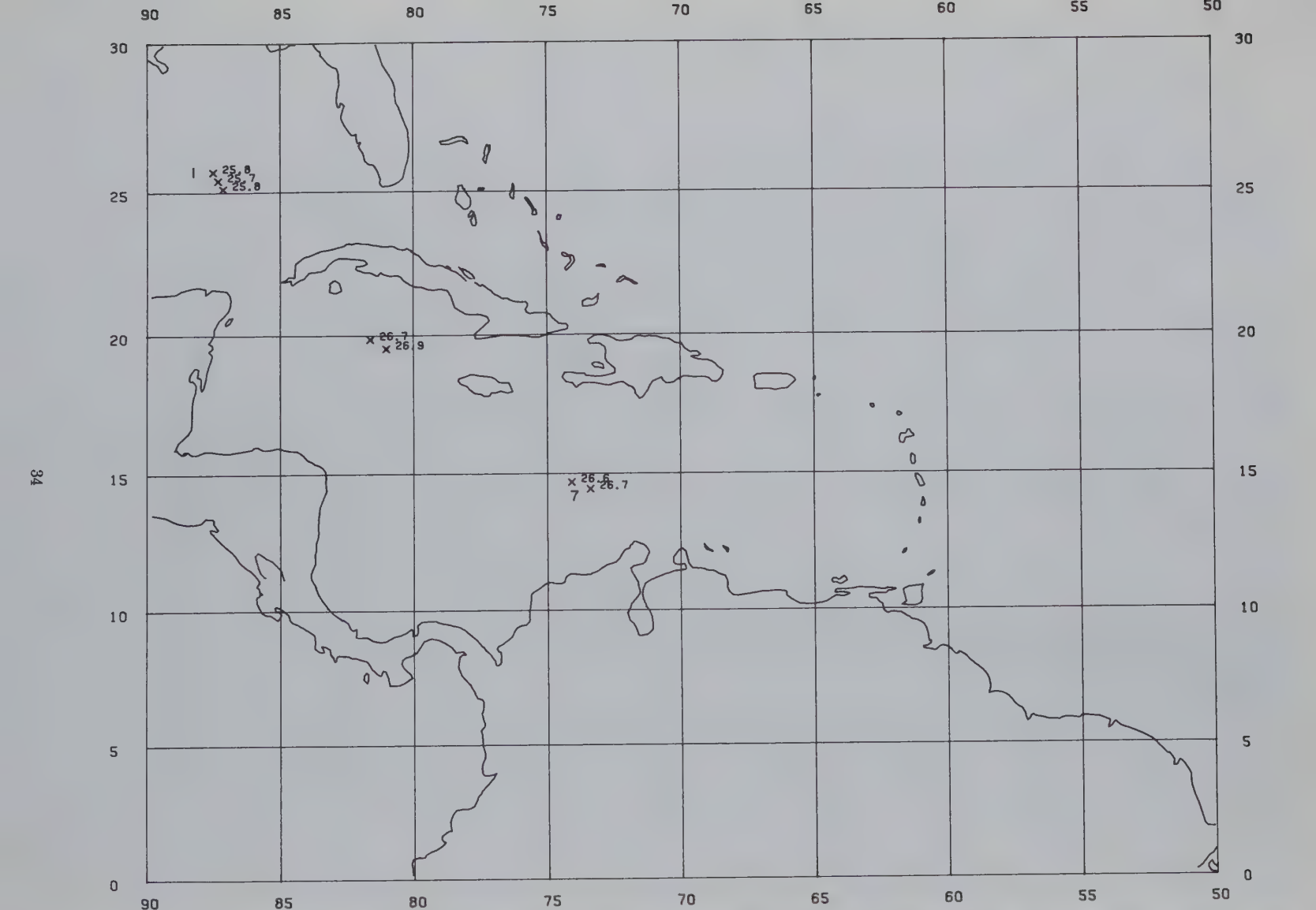


Figure 22. Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Delta Brazil*, 1-3 April 1972.

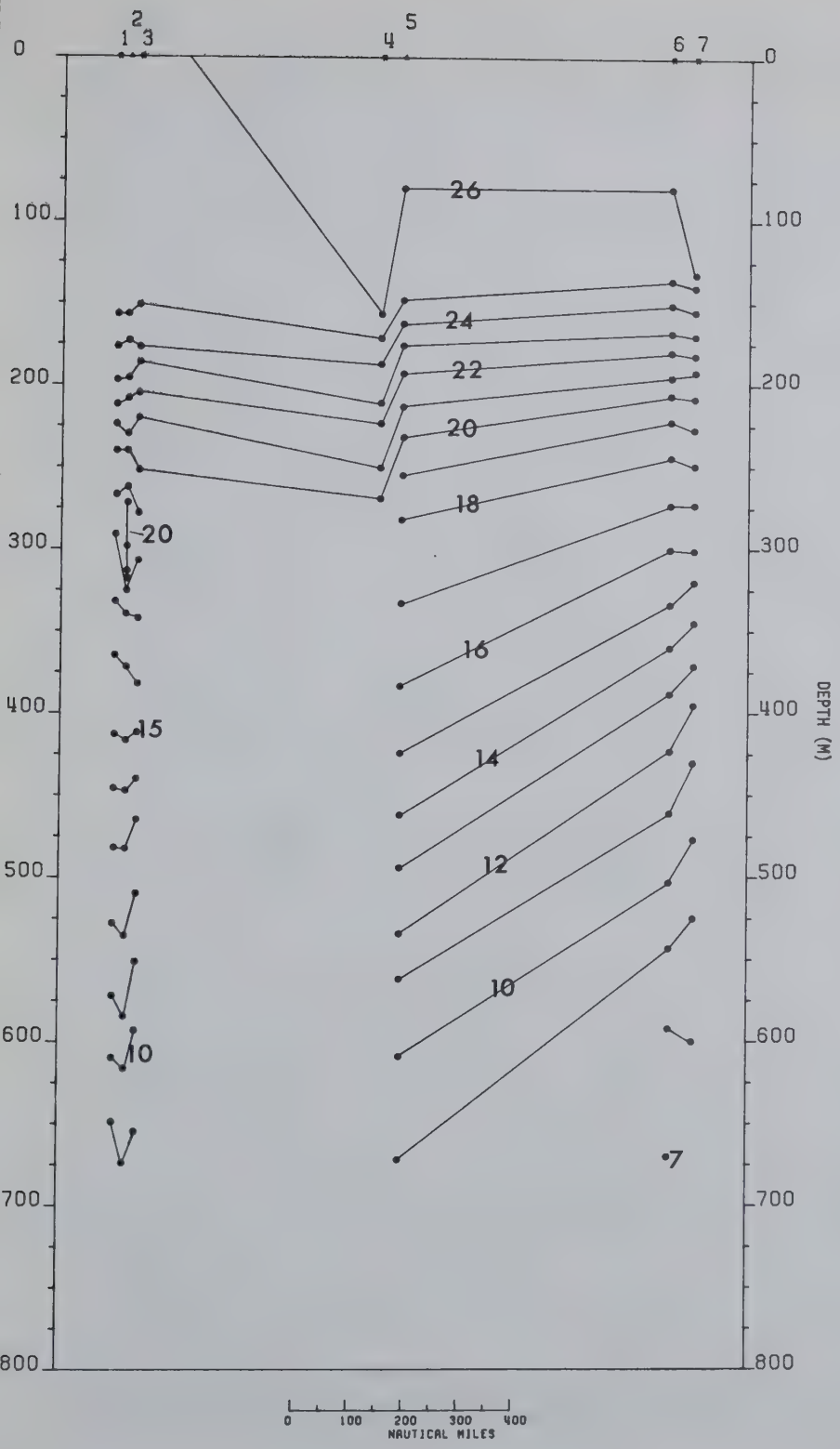


Figure 33.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Delta Brazil*, 1-3 April 1972.

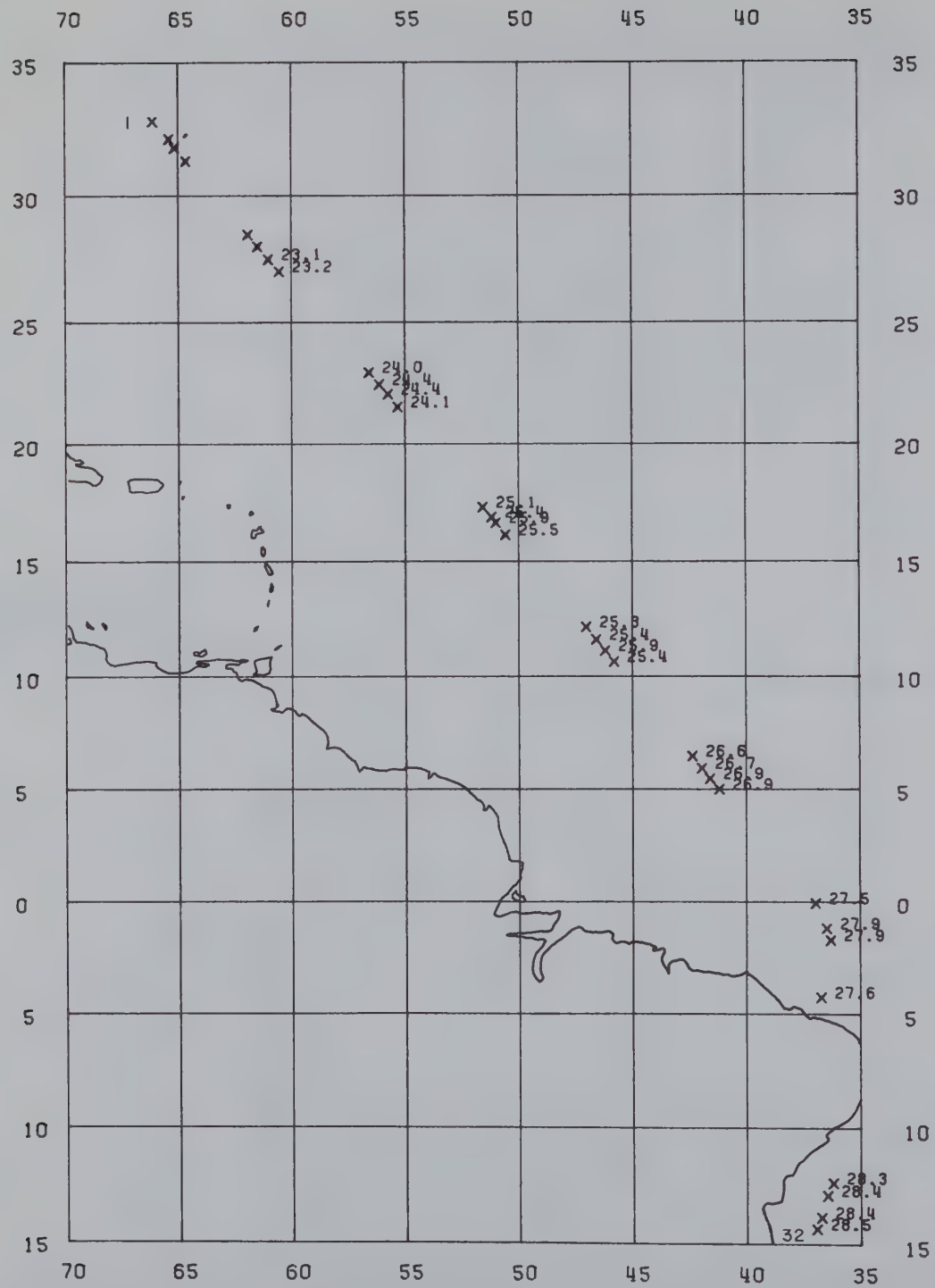


Figure 34.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Cape*, **9-17 April 1972.**

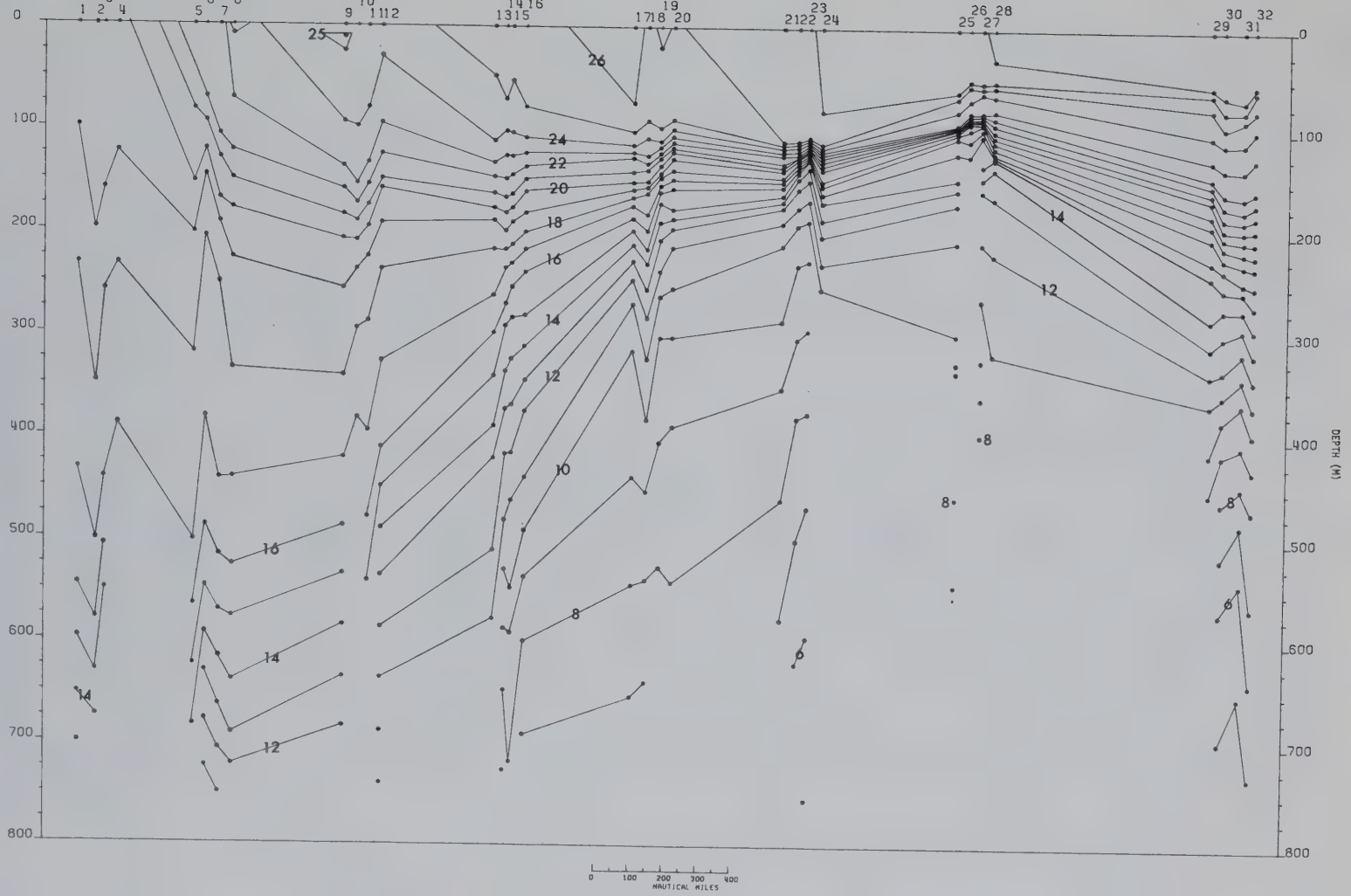


Figure 35.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Cape*, **9-17 April 1972.**

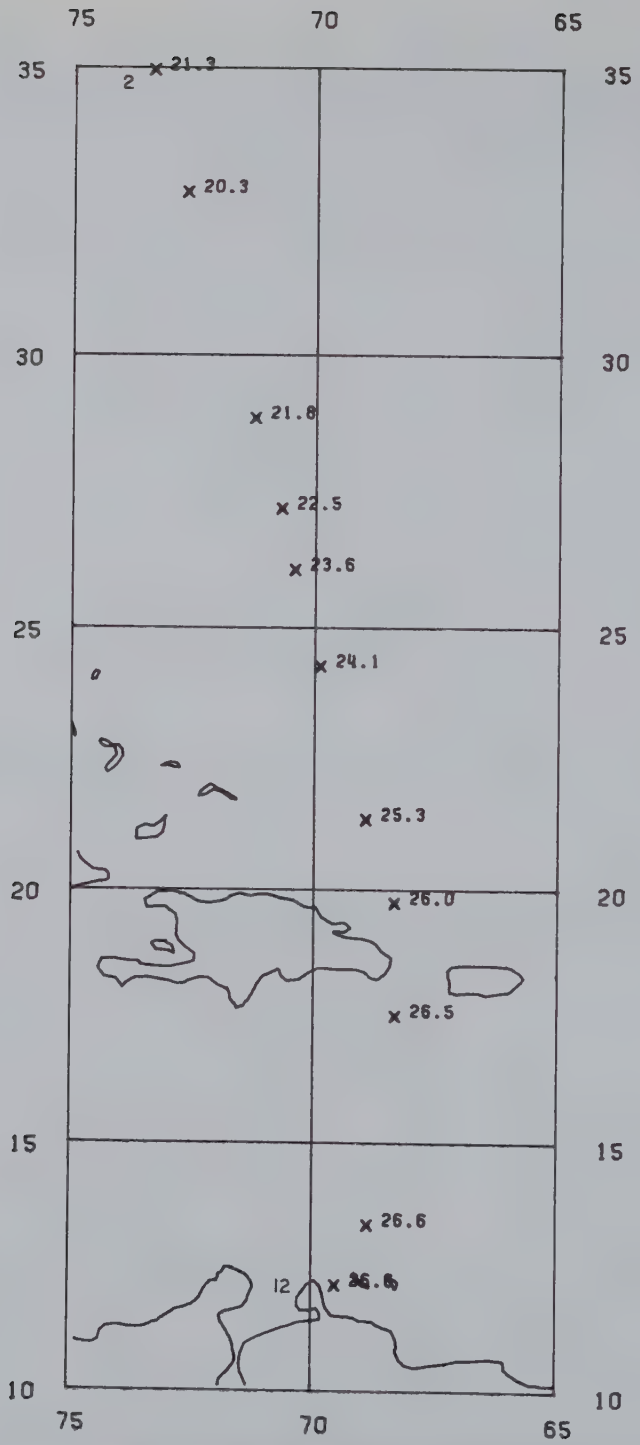


Figure 36.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 4-8 April 1972.

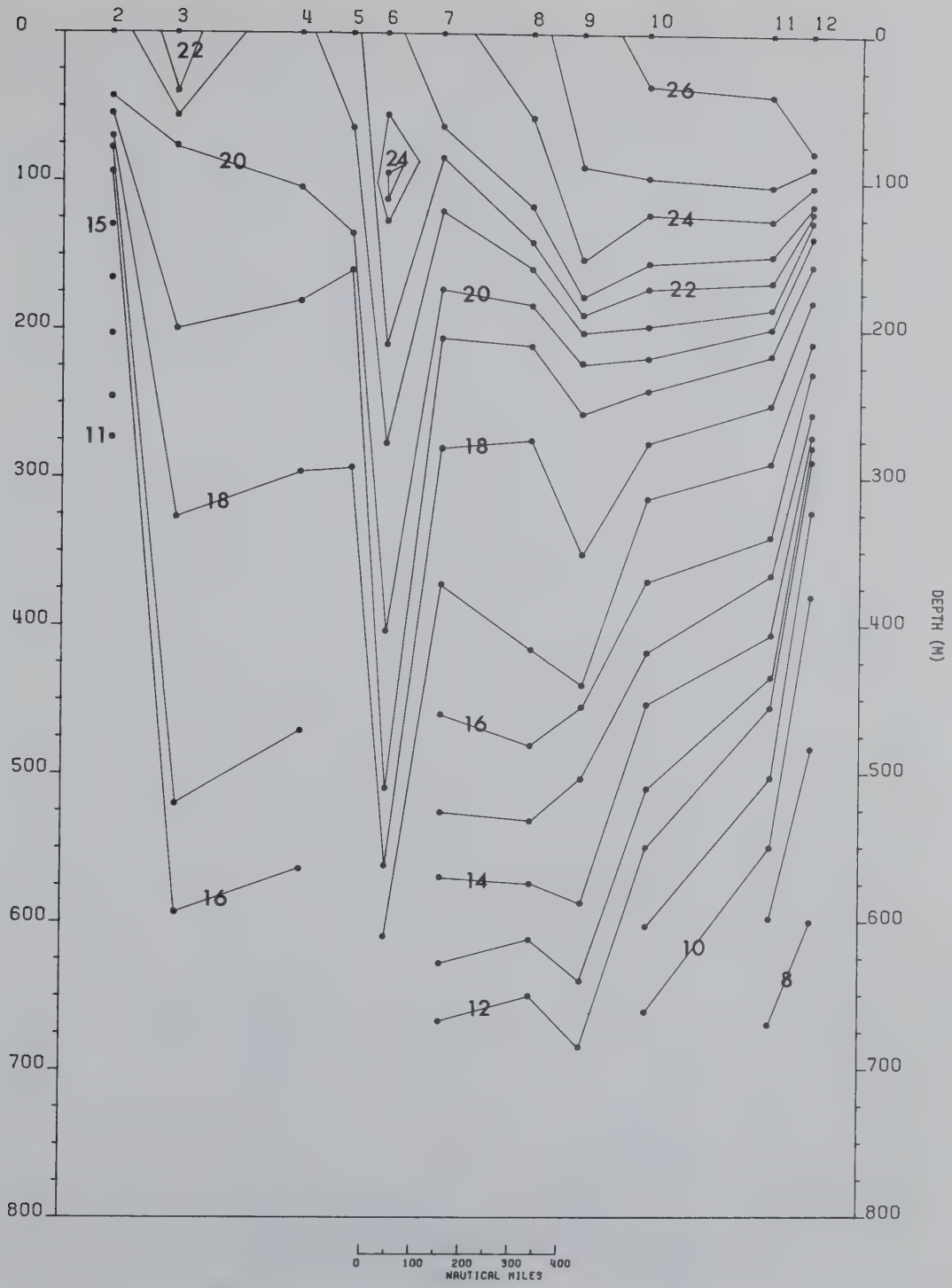


Figure 37.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **4-8 April 1972.**

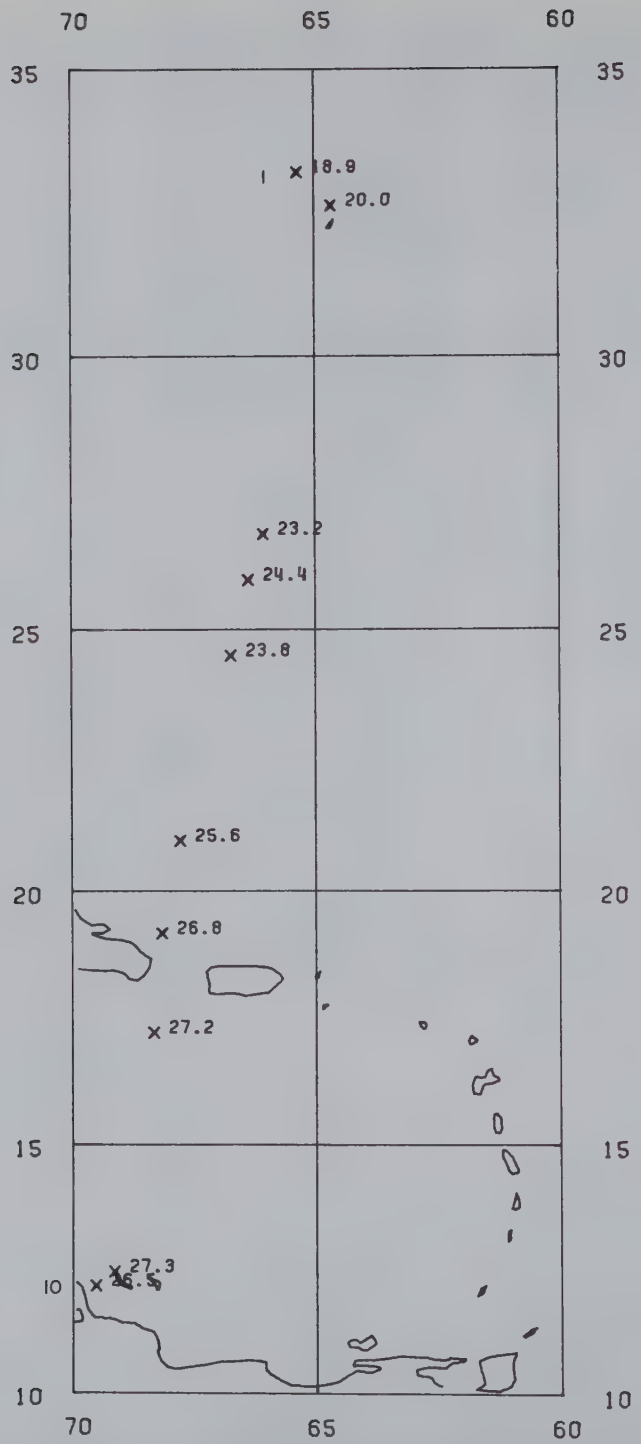


Figure 38.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **1-5 May 1972.**

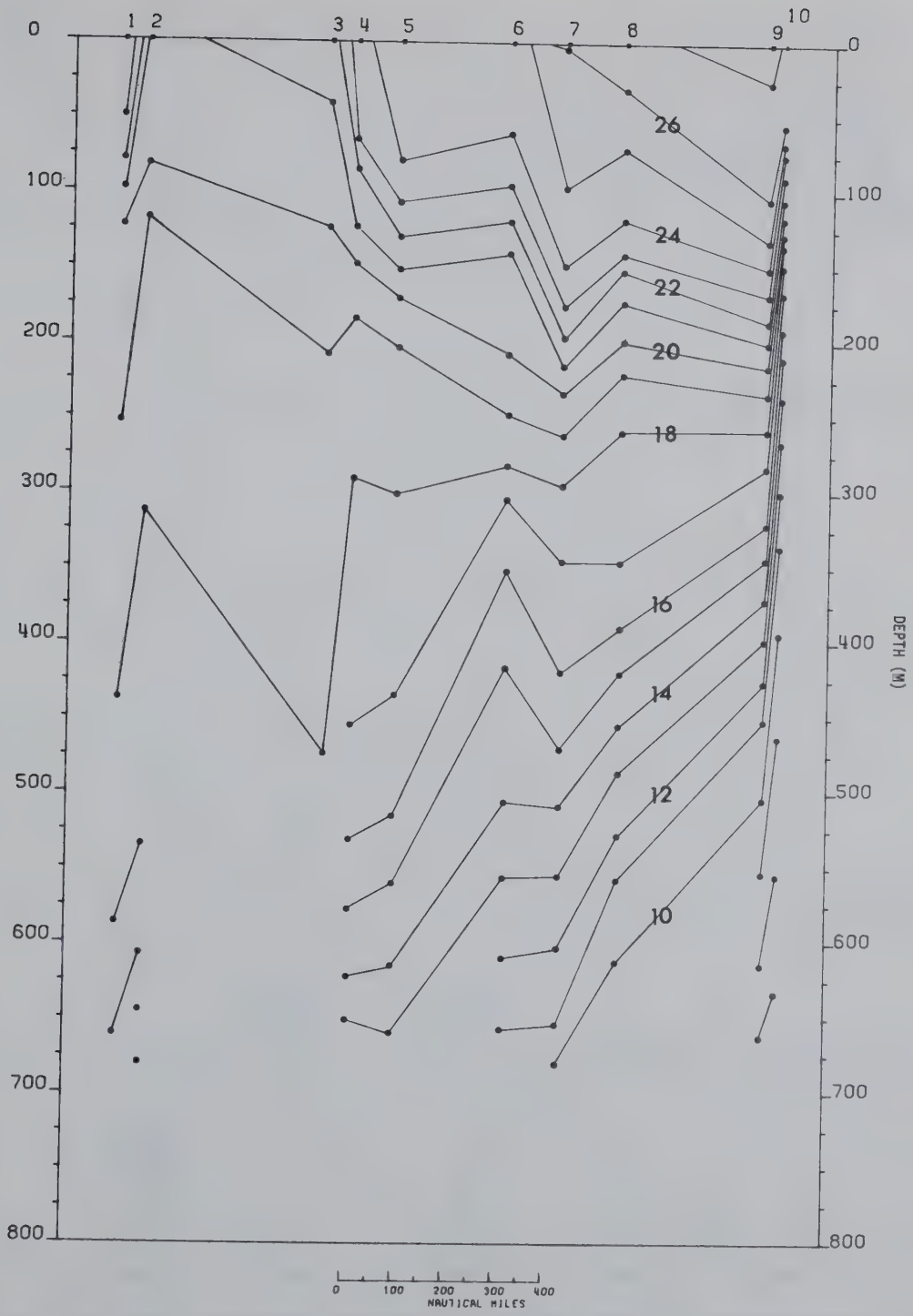


Figure 39.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **1-5 May 1972.**

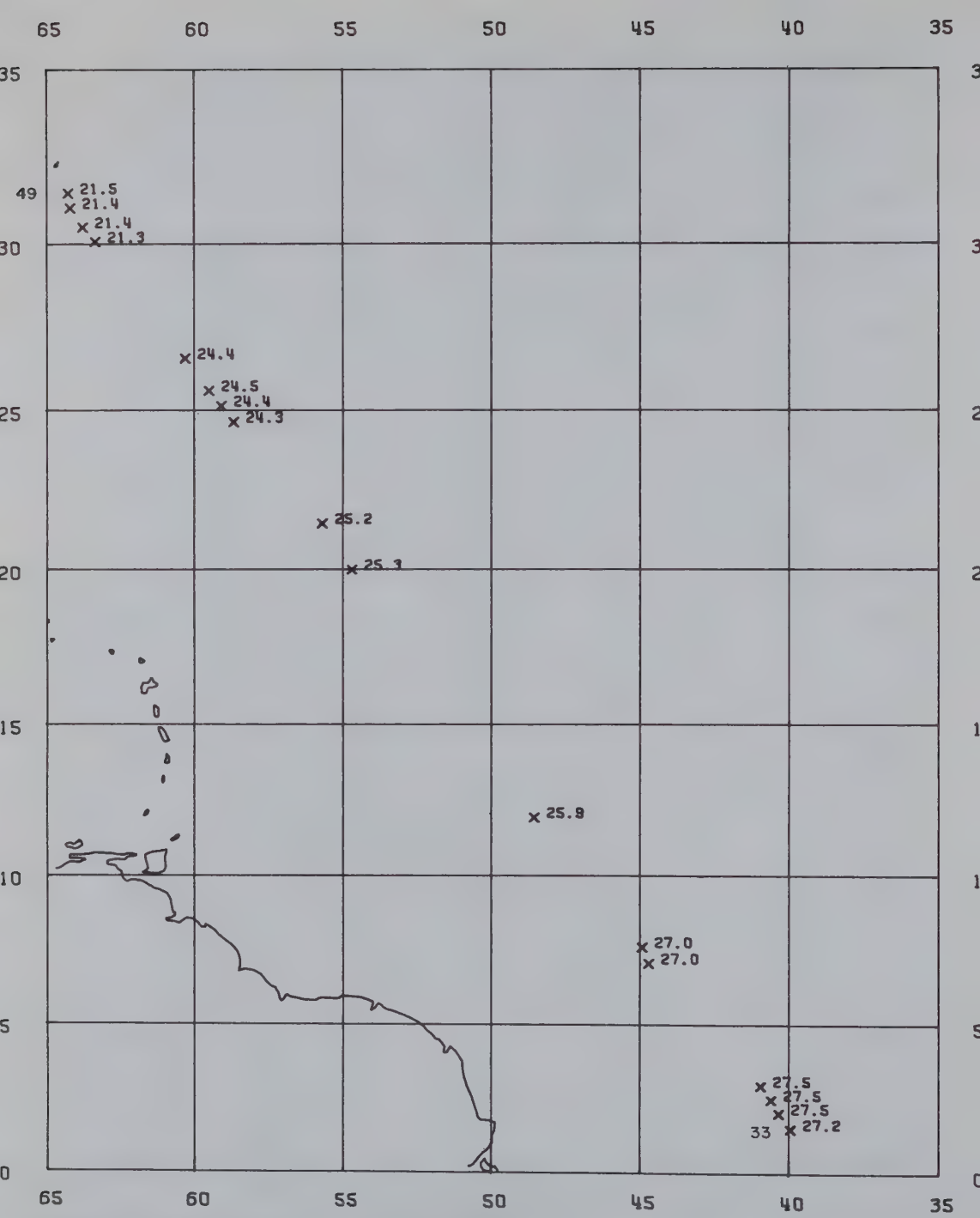


Figure 40.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Cape*, 20-25 May 1972.

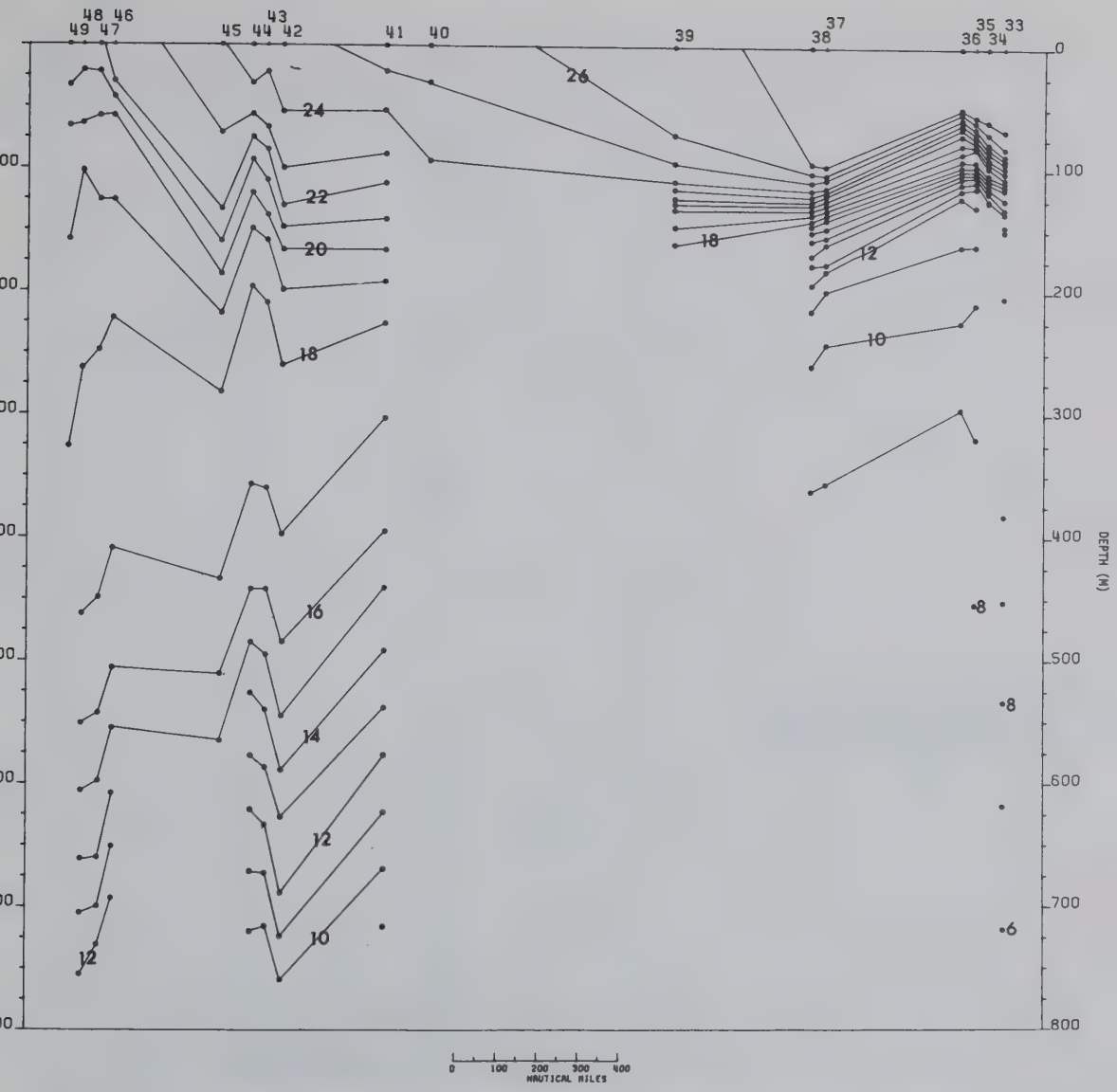


Figure 41.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Cape*, **20-25 May 1972.**

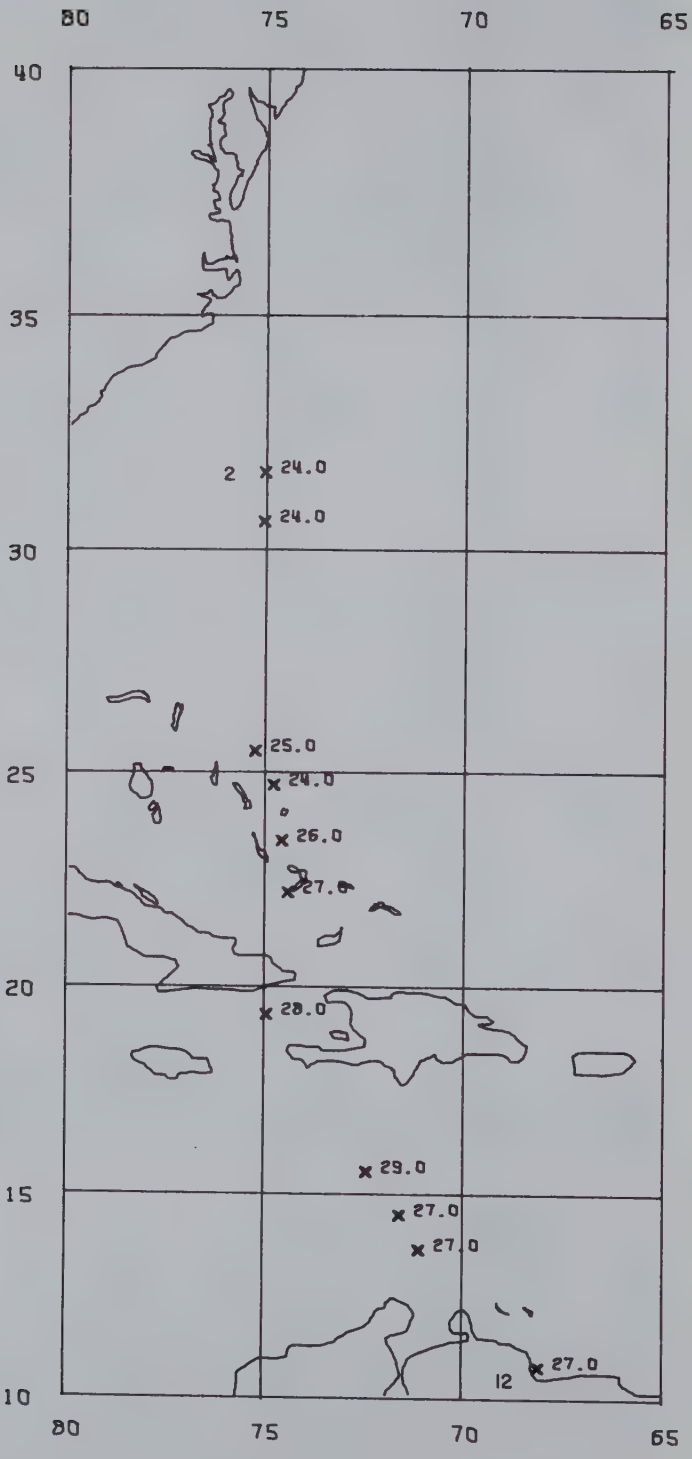


Figure 42.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **29 May-8 June 1972.**

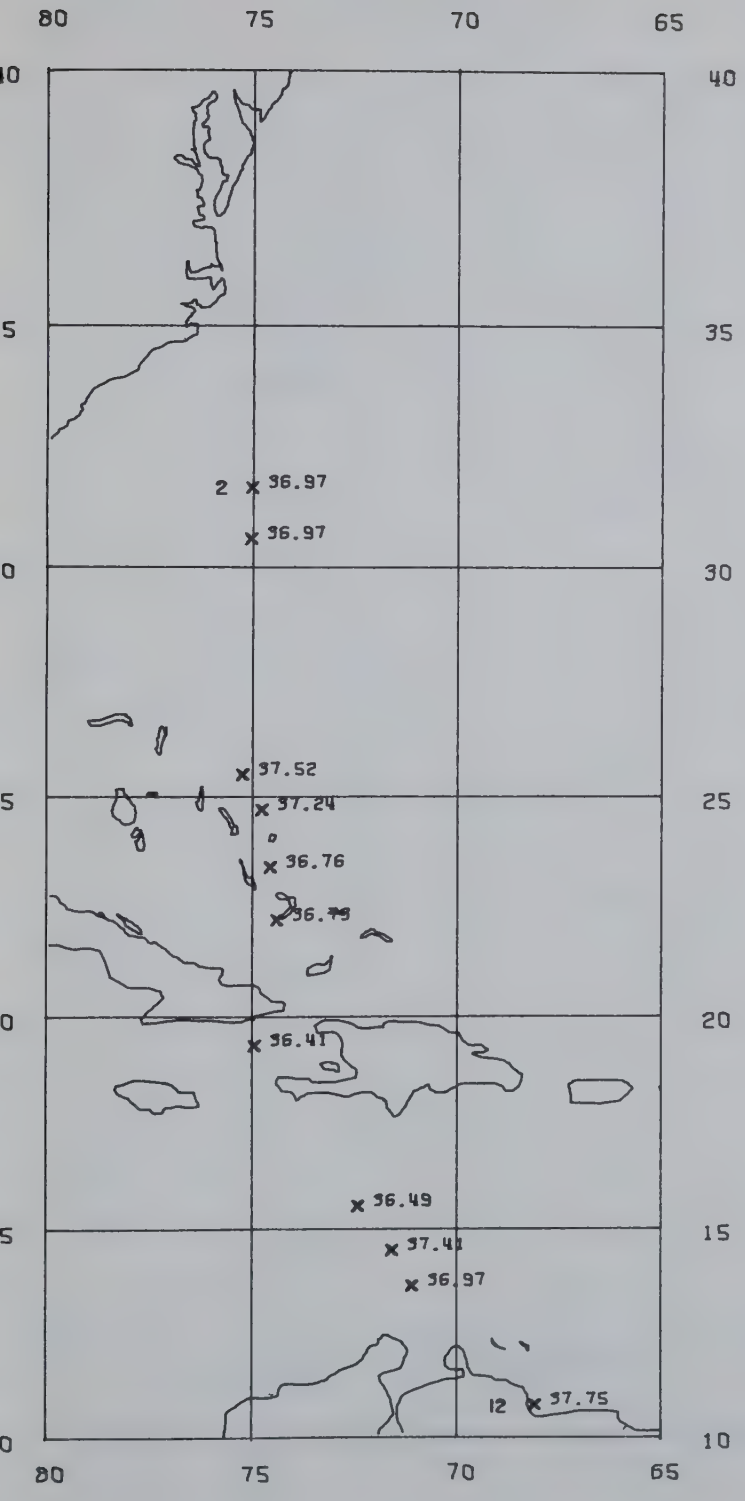


Figure 43.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **29 May-8 June 1972.**

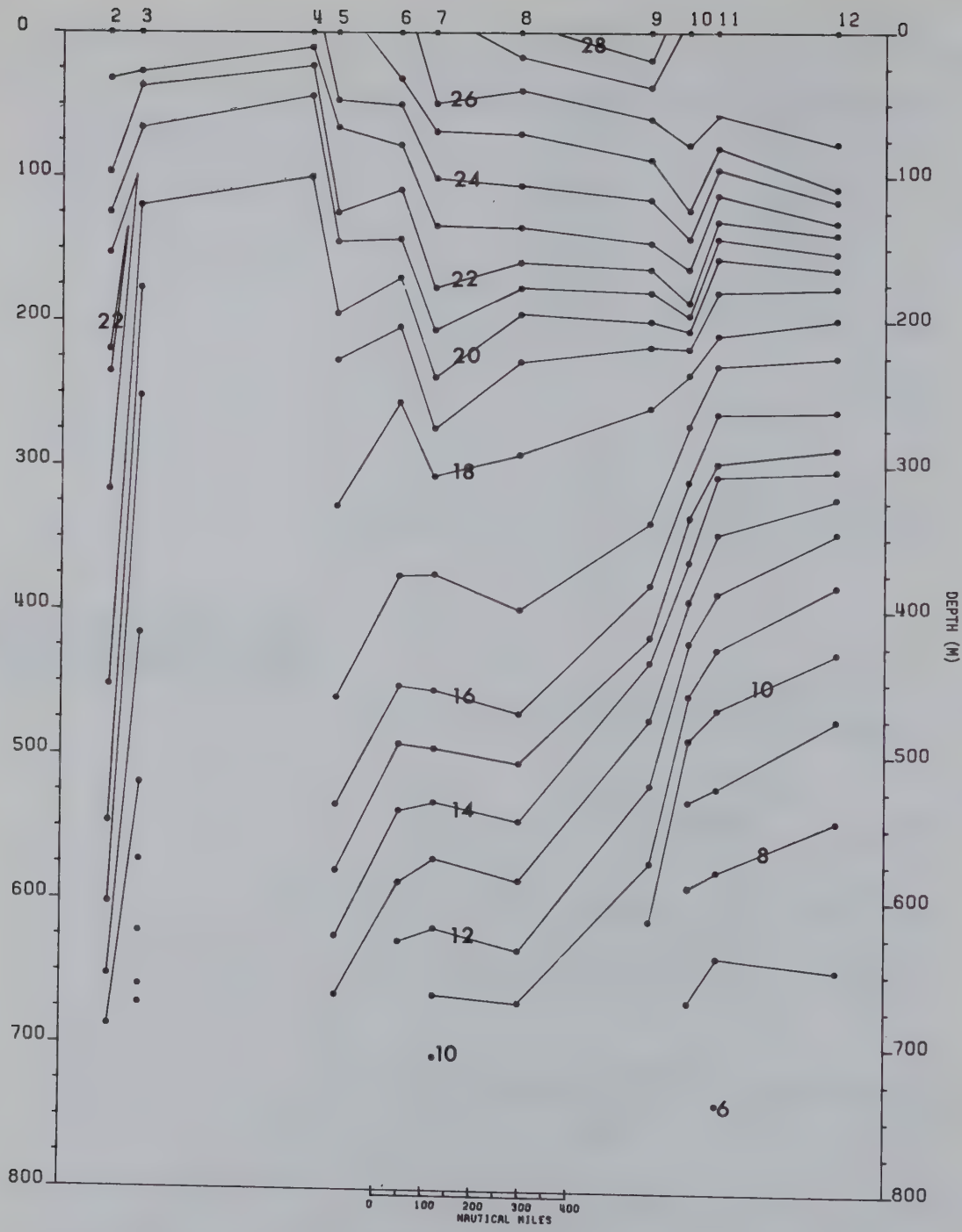


Figure 44.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, 29 May-8 June 1972.

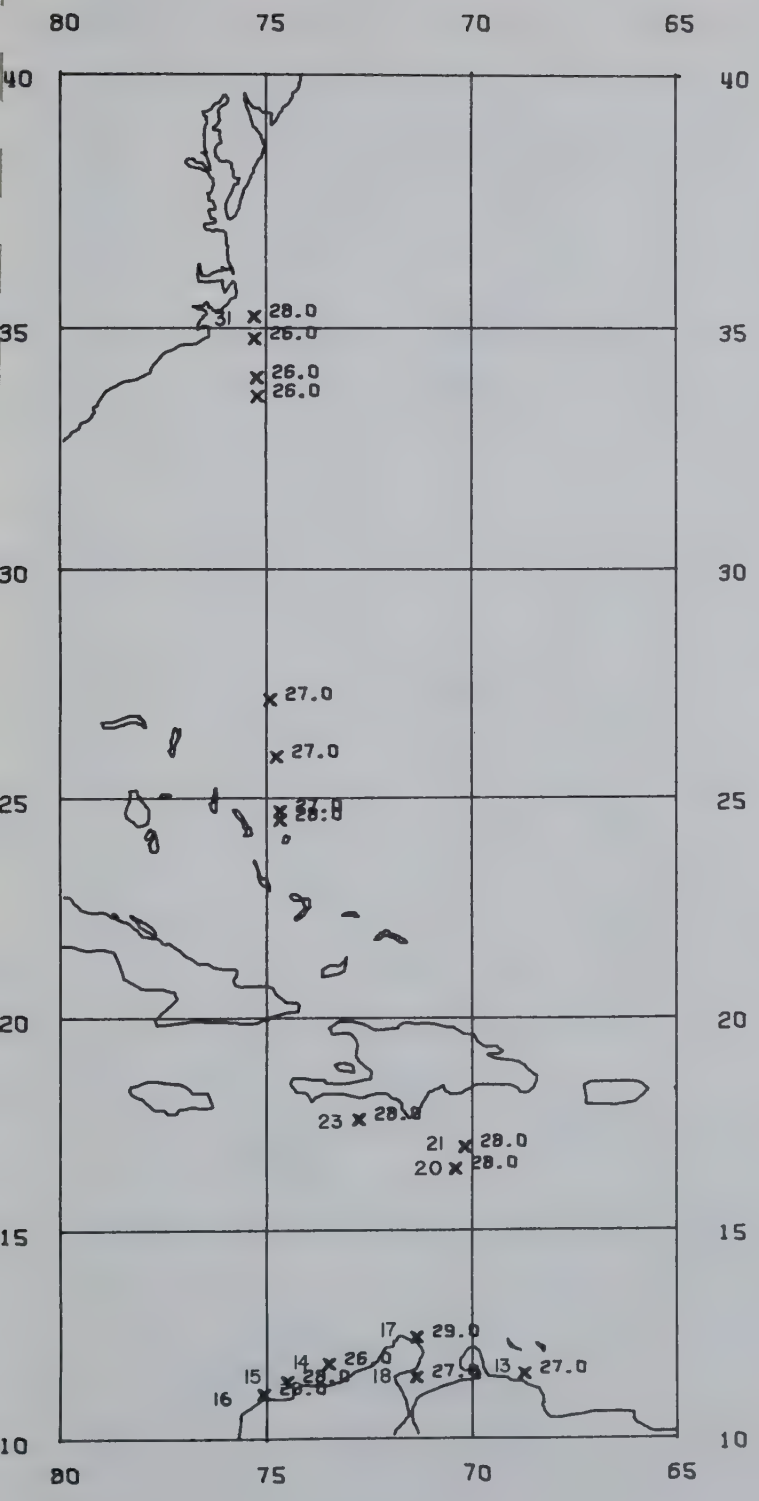


Figure 45.—Sea surface temperature (°C) alon
the cruise track with the first and last statio
numbered. *Santa Cruz*, 8-18 June 1972.

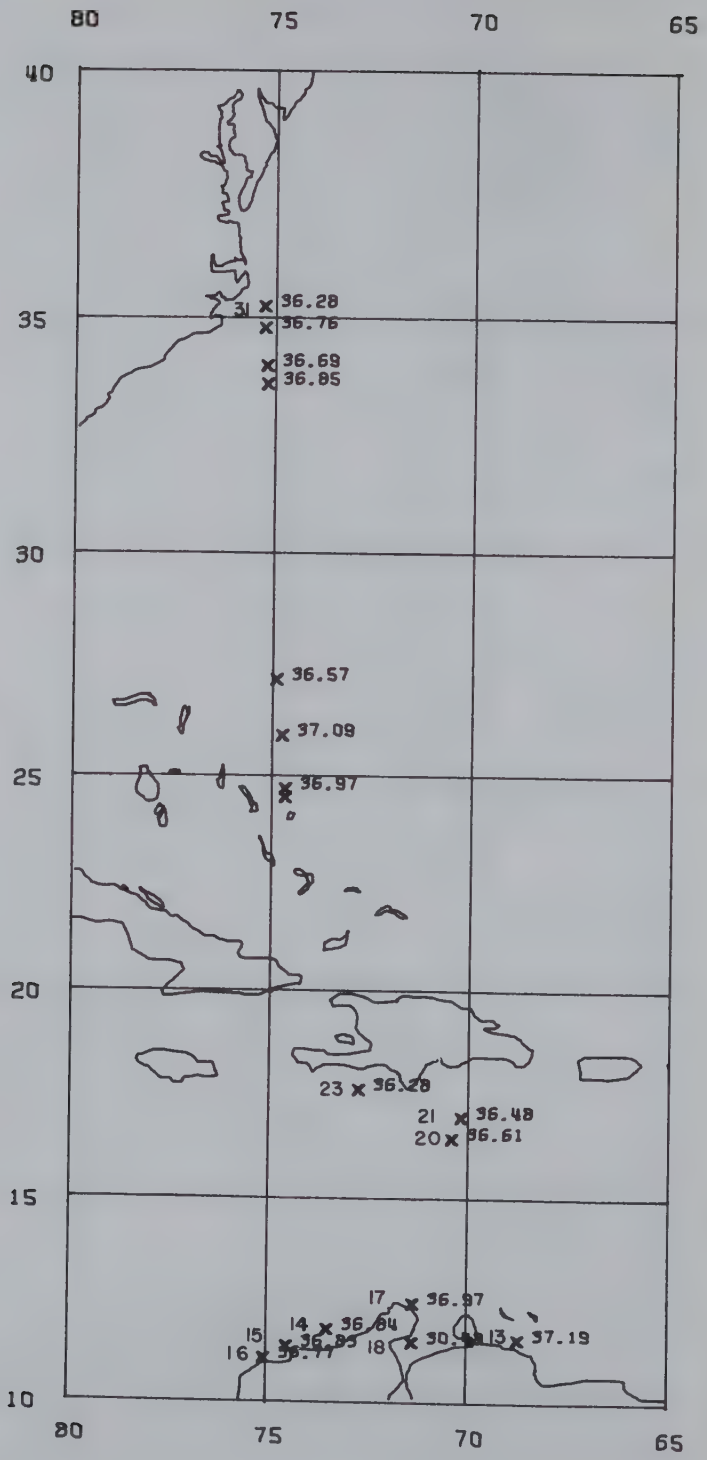


Figure 46.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 8-18 June 1972.

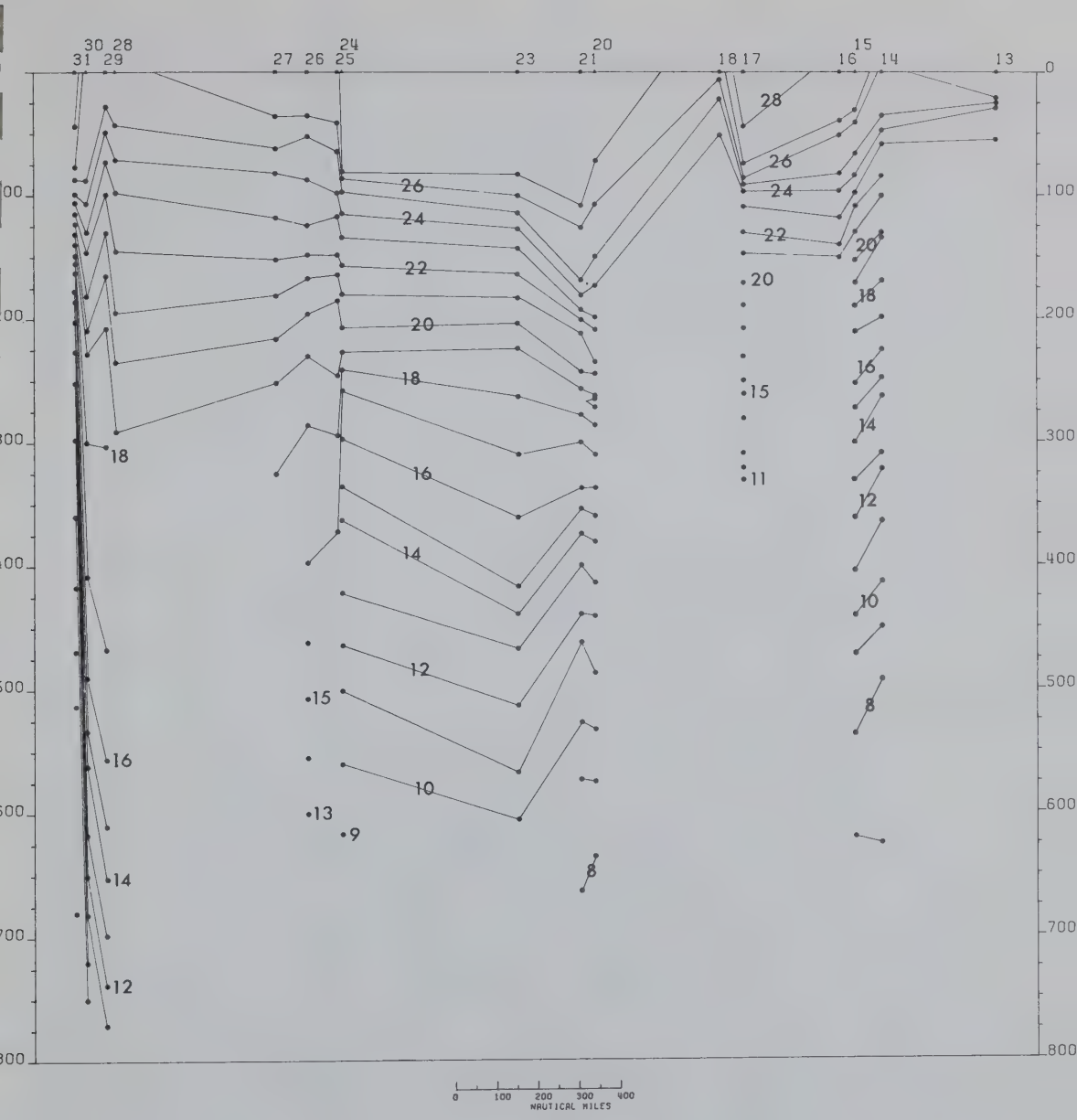


Figure 47.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, 8-18 June 1972.

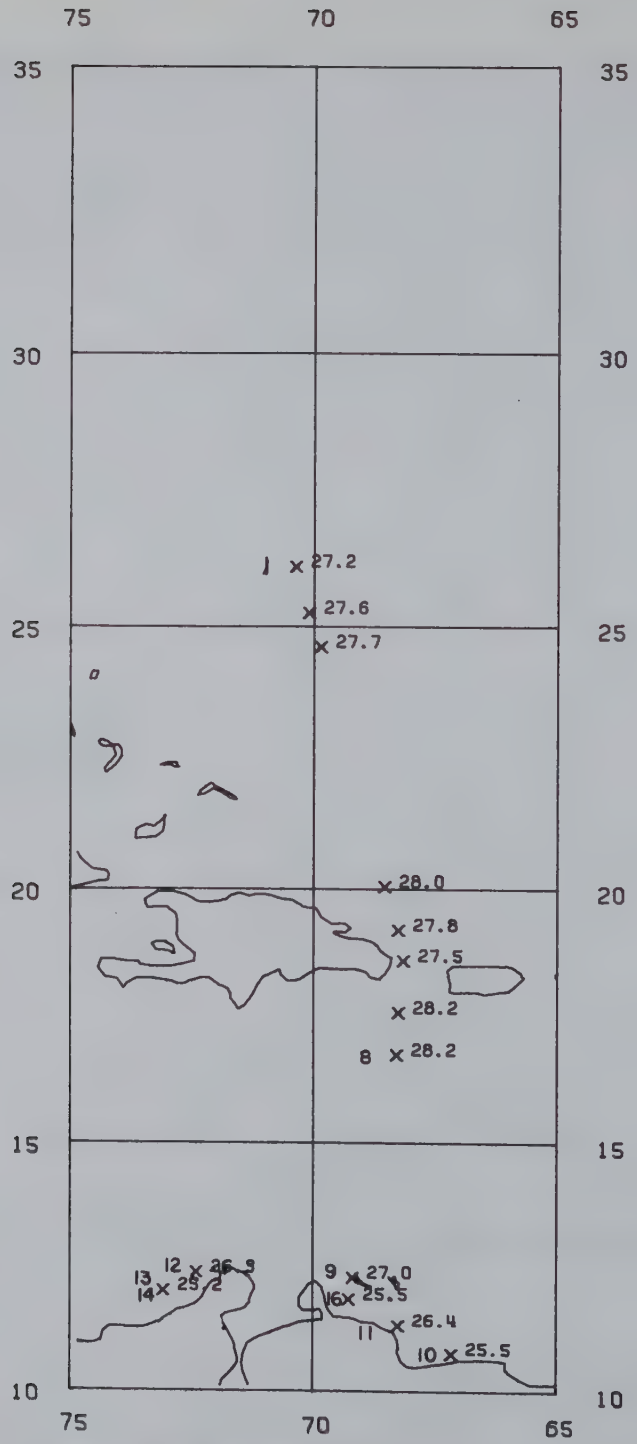


Figure 48.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **28 June-14 July 1972.**

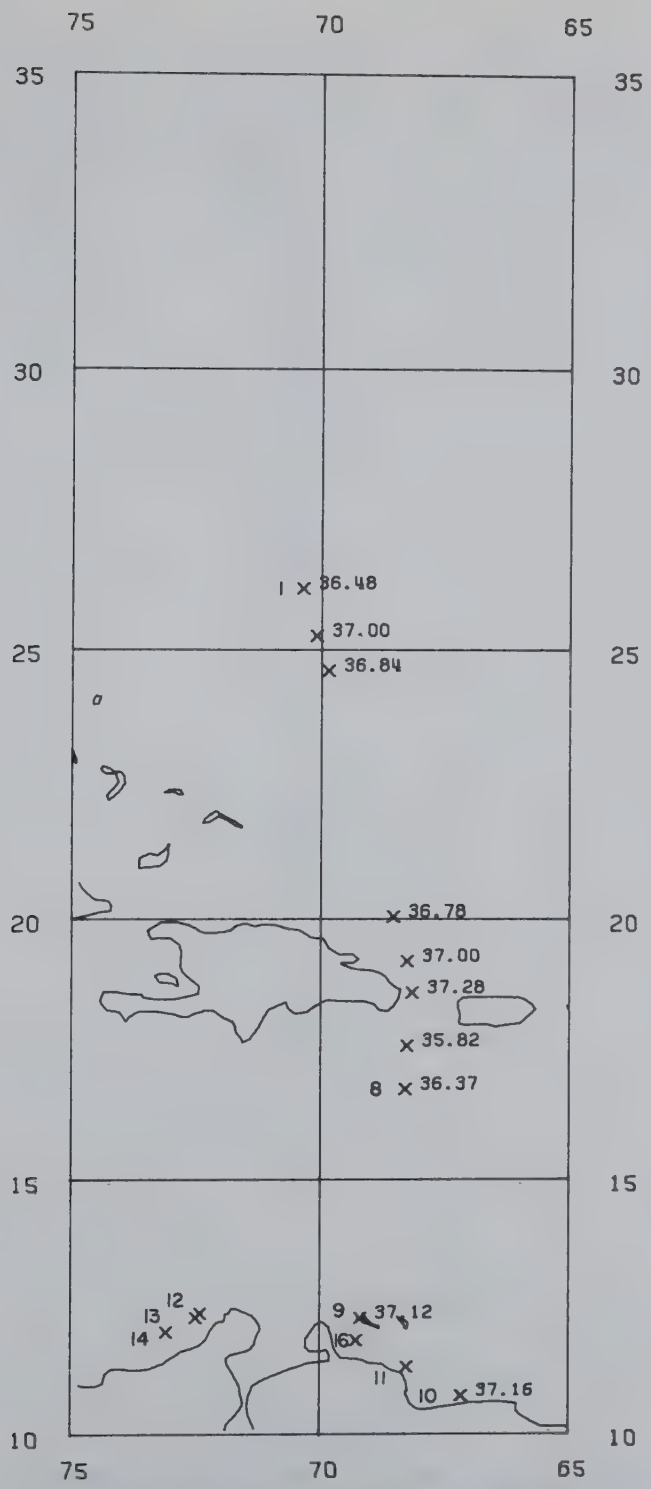


Figure 49.— Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **28 June-14 July 1972.**

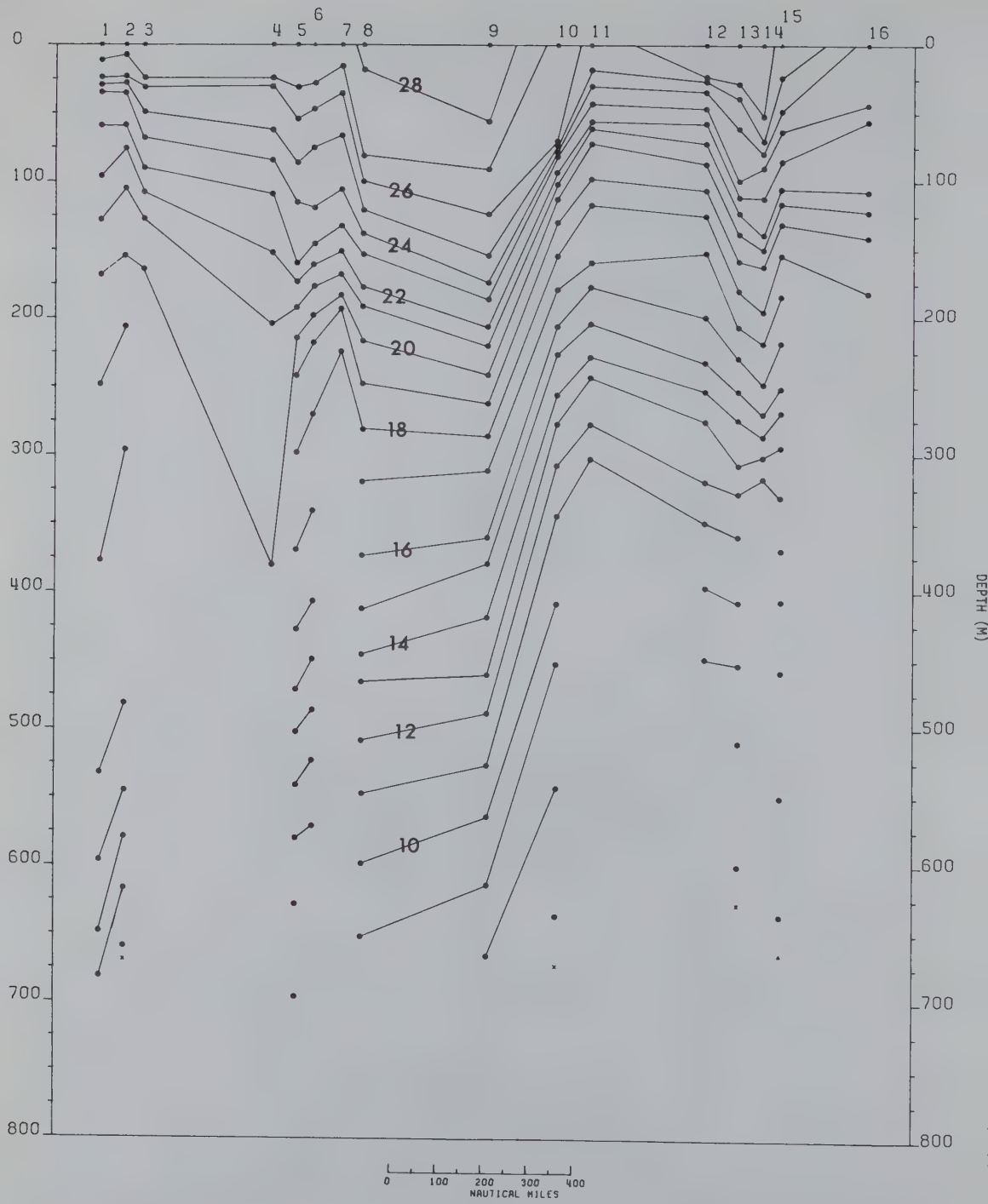


Figure 50.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **28 June-14 July 1972.**

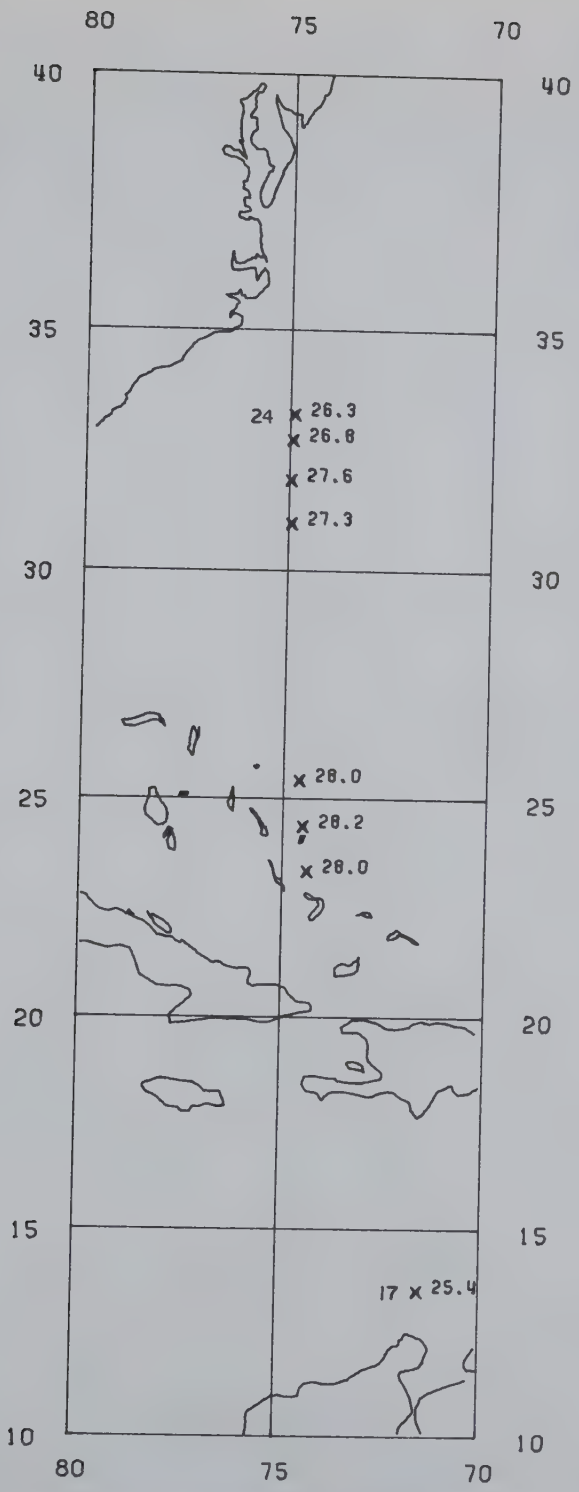


Figure 51.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **15-18 July 1972.**

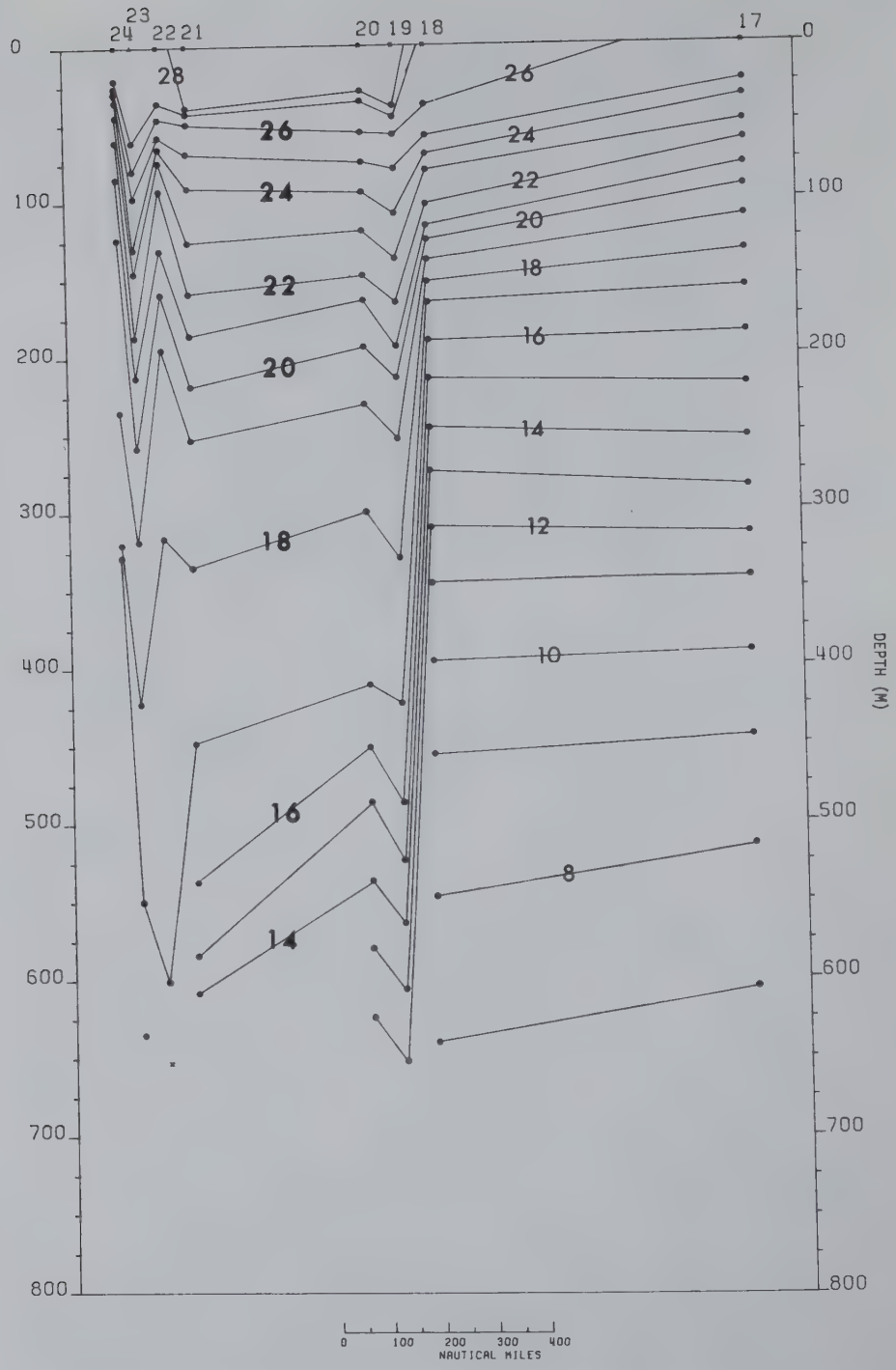


Figure 52.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **15-18 July 1972.**

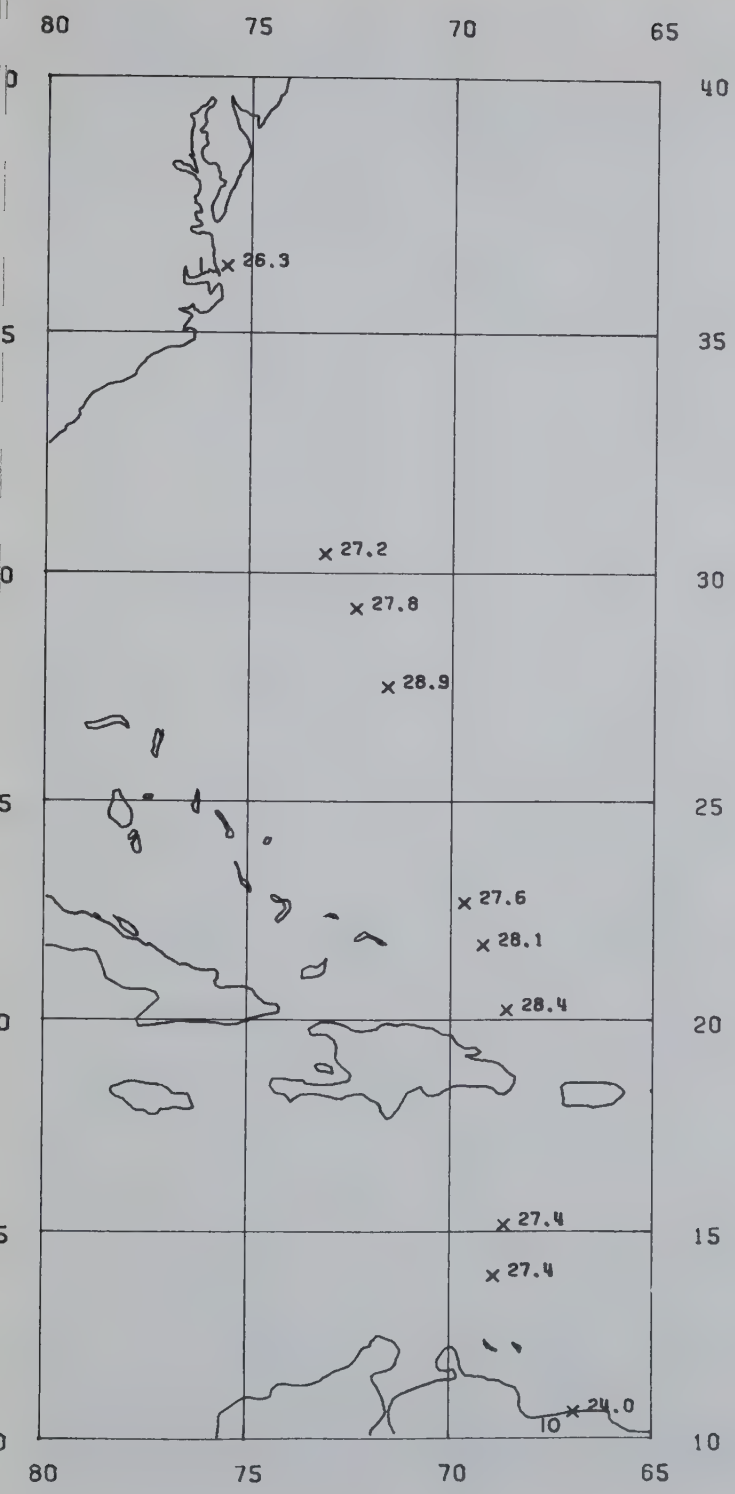


Figure 53.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **25-31 July 1972.**

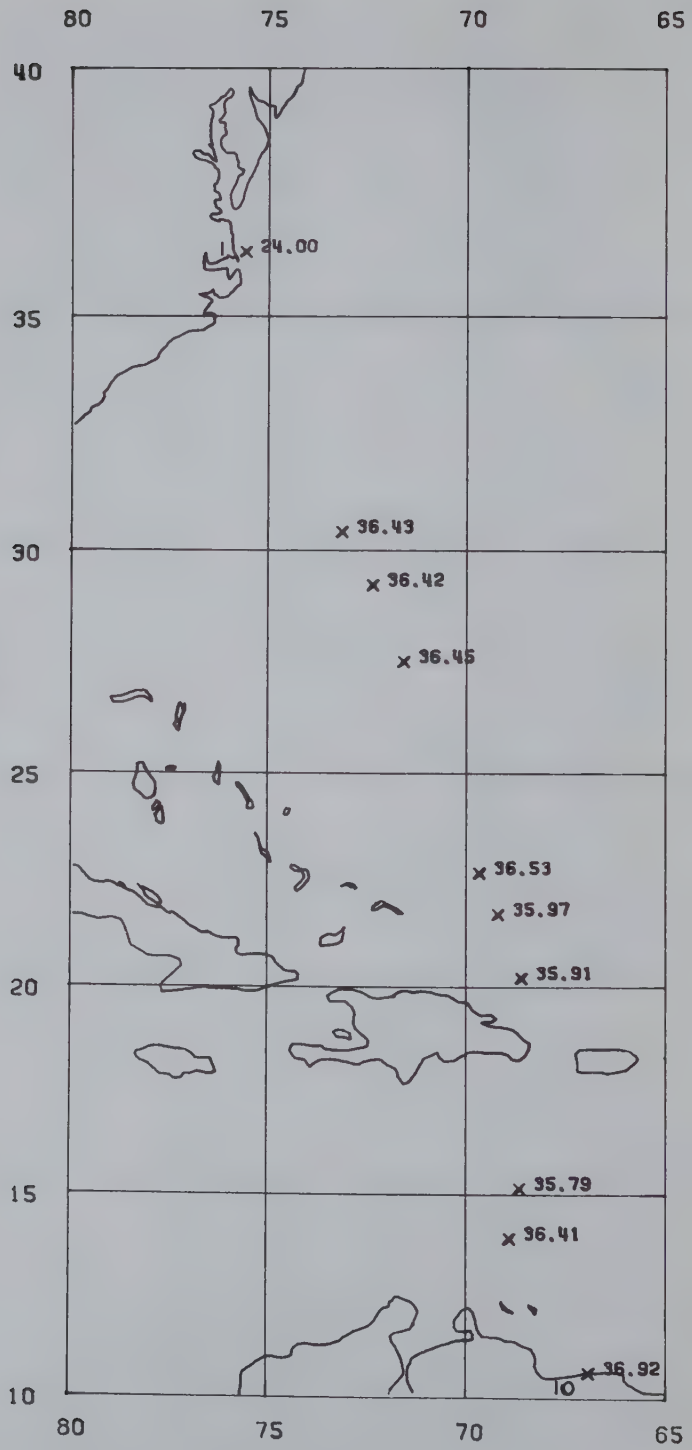


Figure 54.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **25-31 July 1972.**

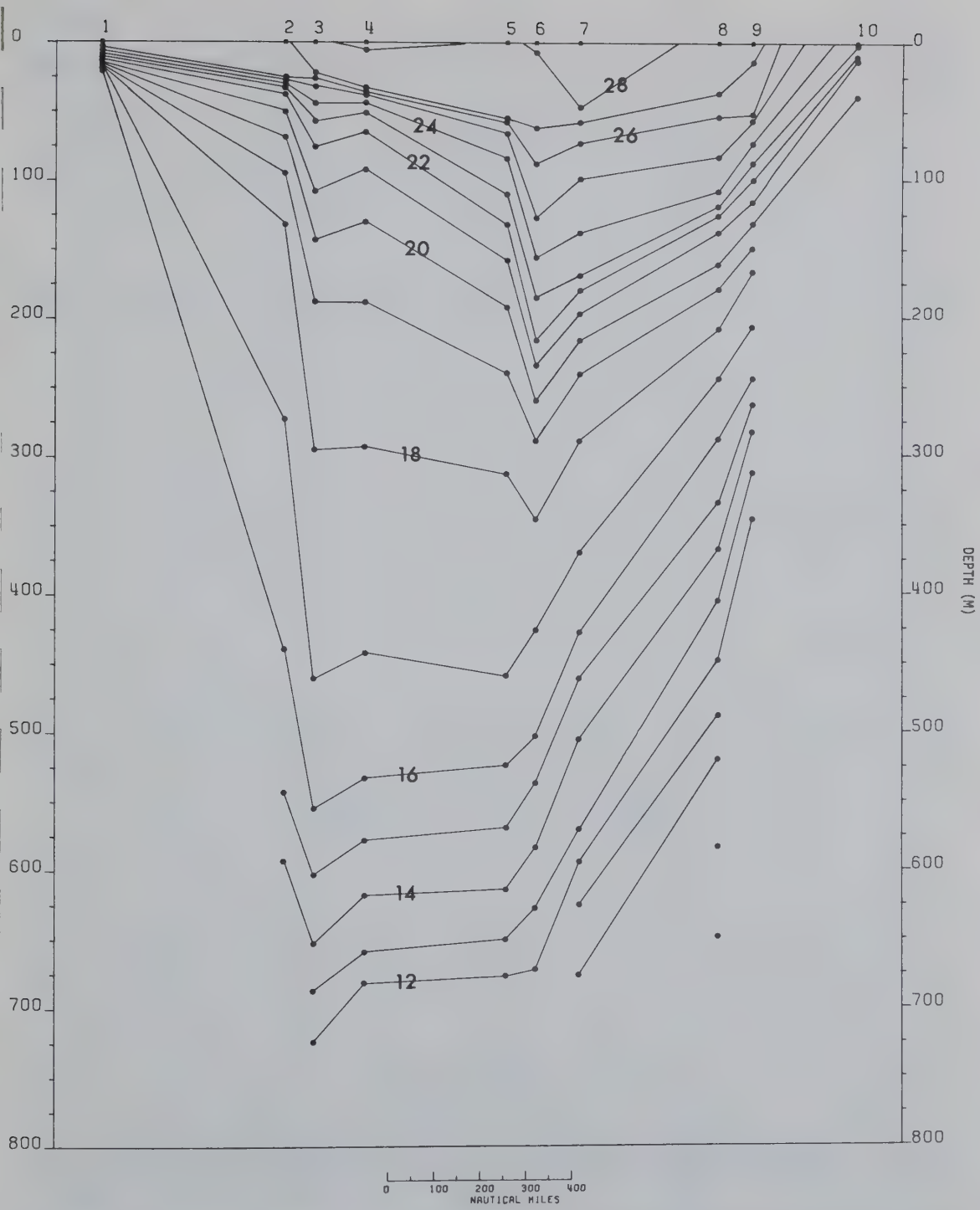


Figure 55.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **25-31 July 1972.**

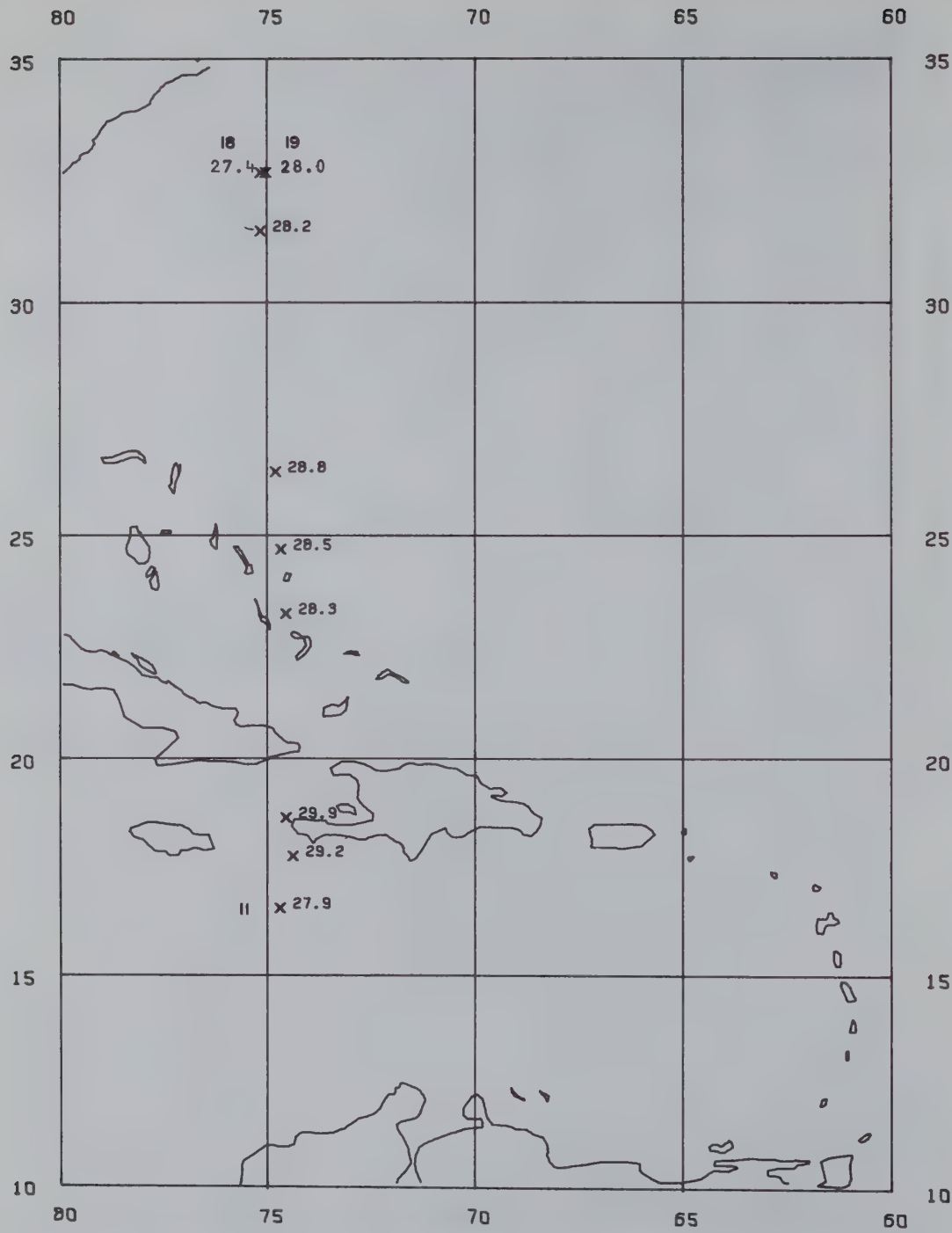


Figure 56.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 11-14 August 1972.

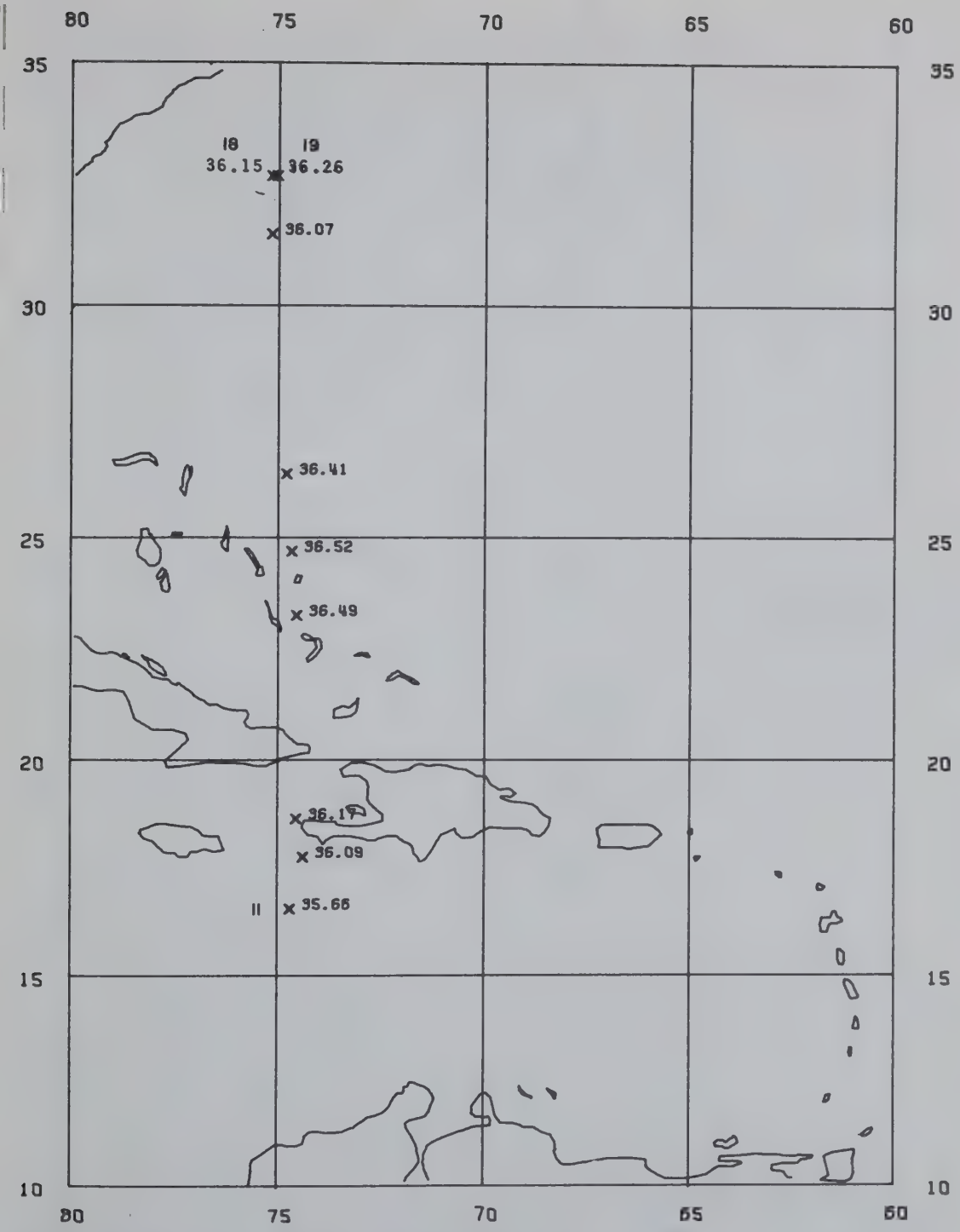


Figure 57.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz,* **11-14 August 1972.**

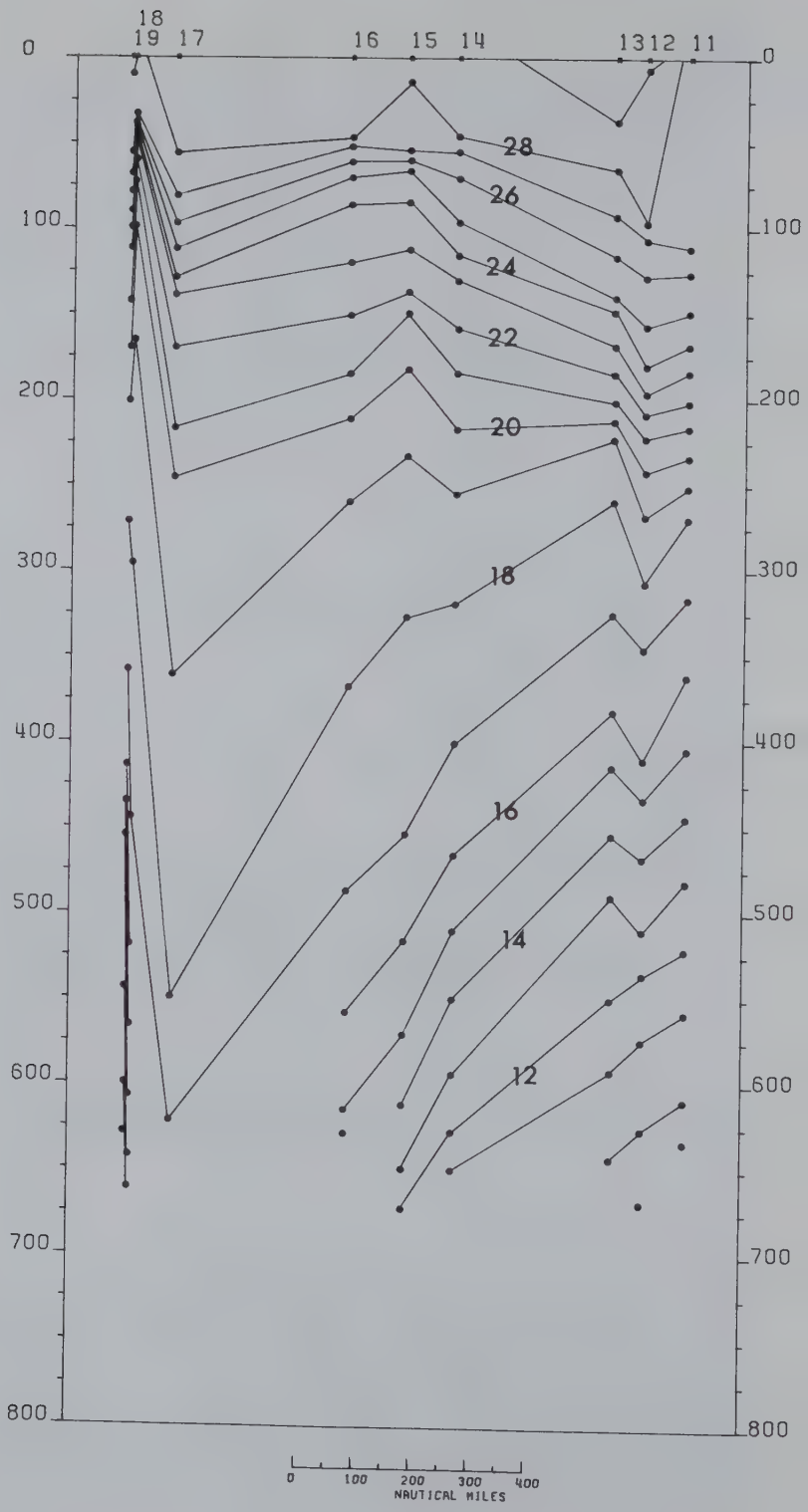


Figure 58.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **11-14 August 1972.**

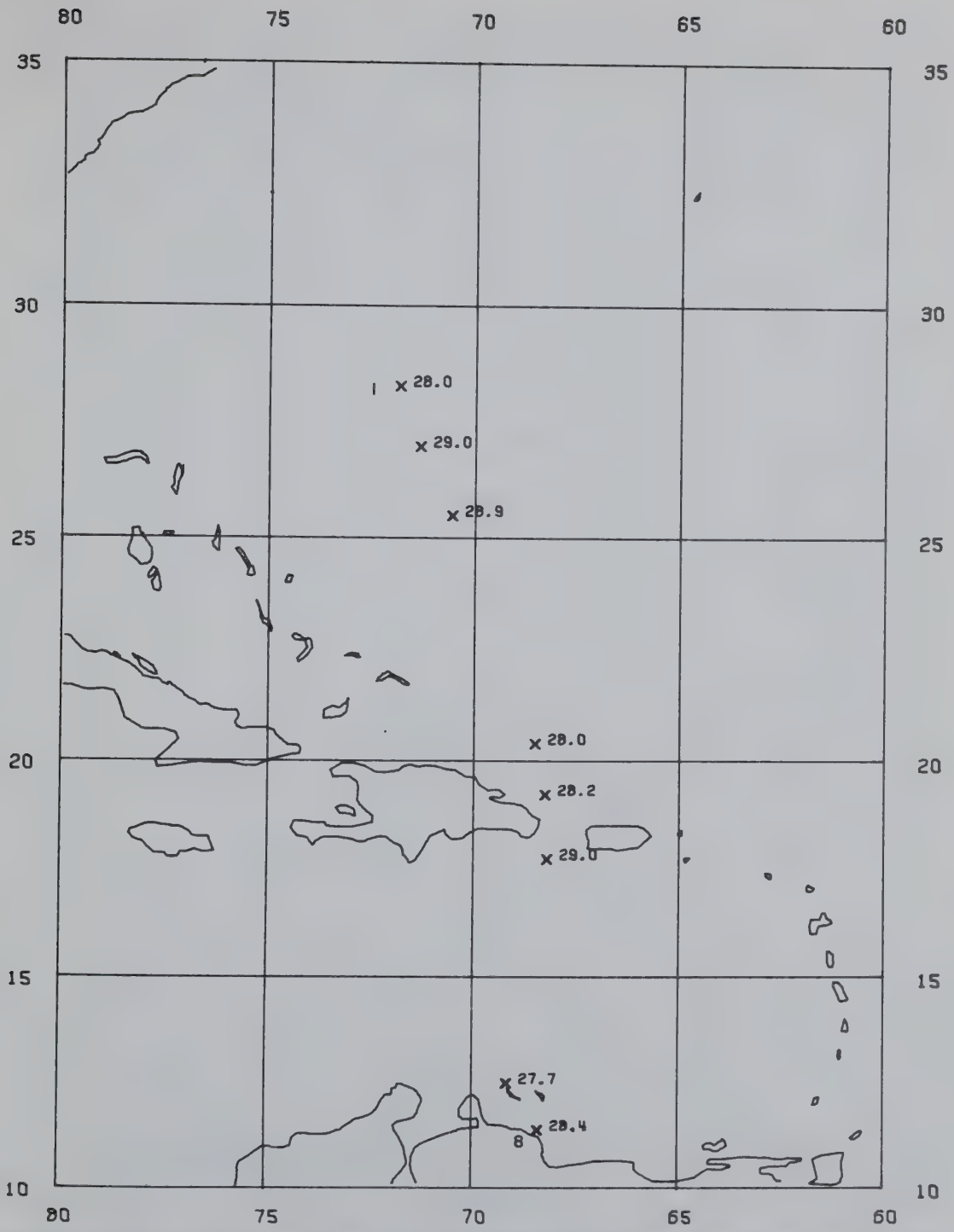


Figure 59.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 21 August-1 September 1972.

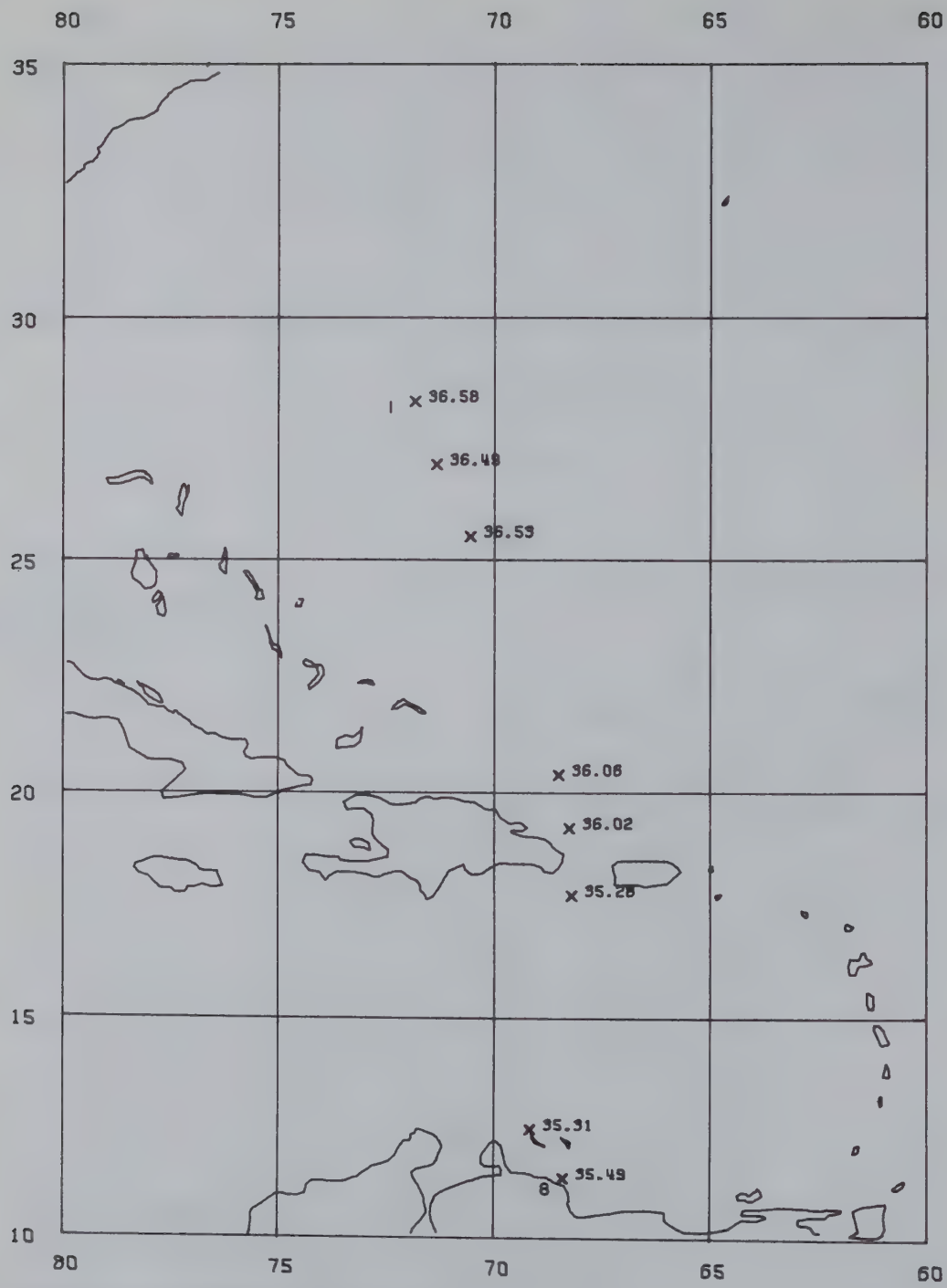


Figure 60.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 21 August-1 September 1972.

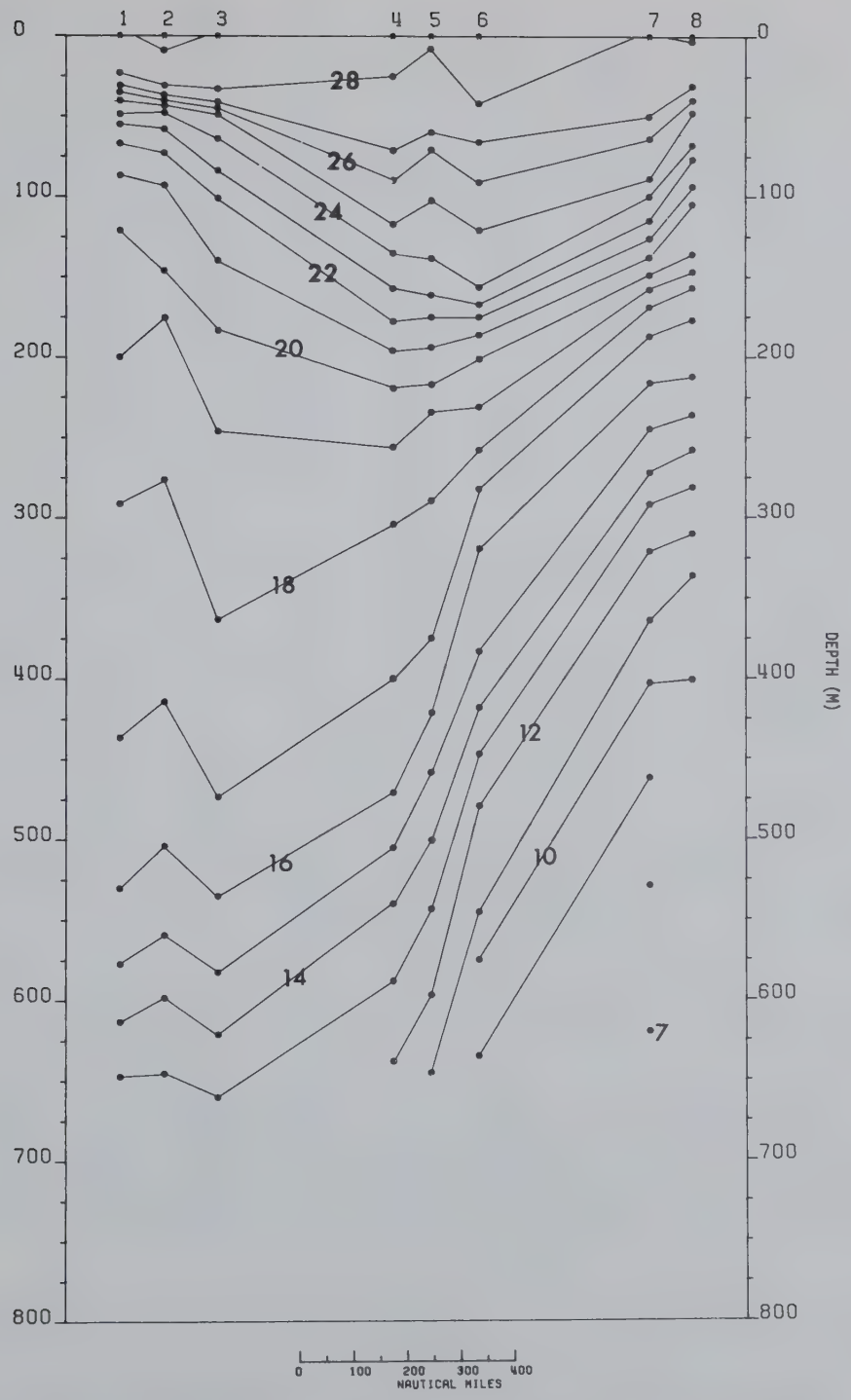


Figure 61.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **21 August-1 September 1972.**

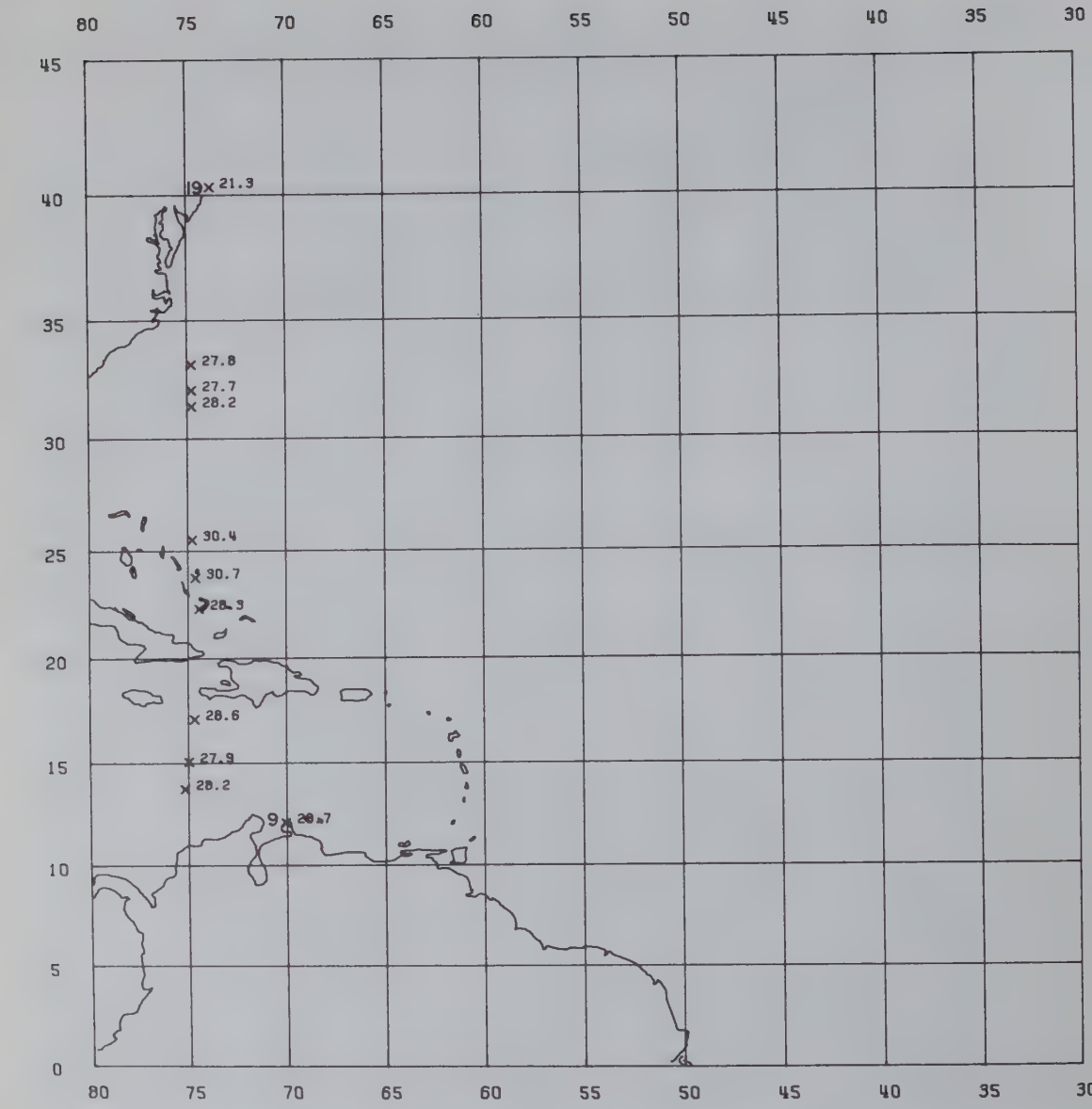


Figure 62.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 2-13 September 19

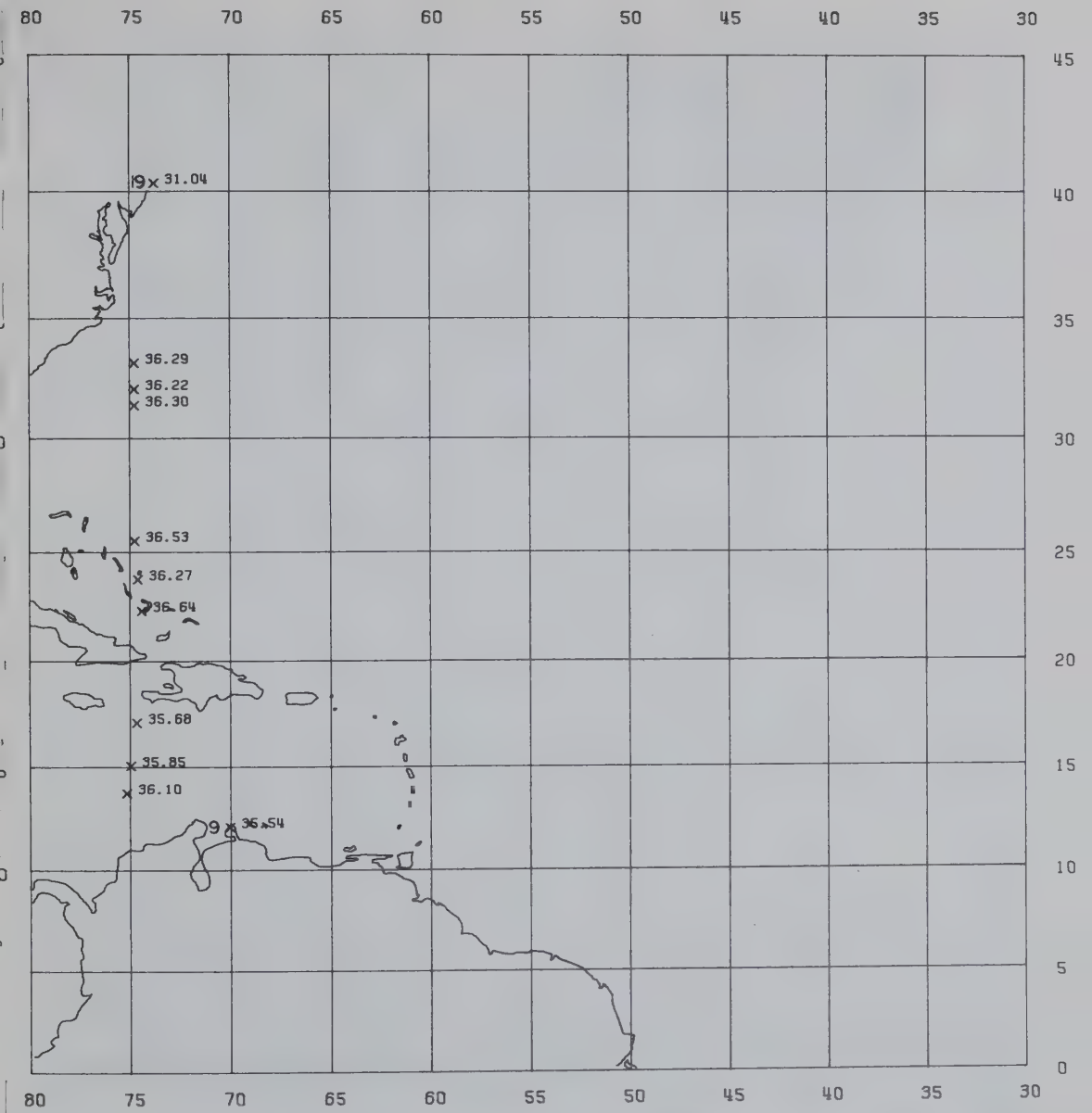


Figure 63.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **2-13 September 1972.**

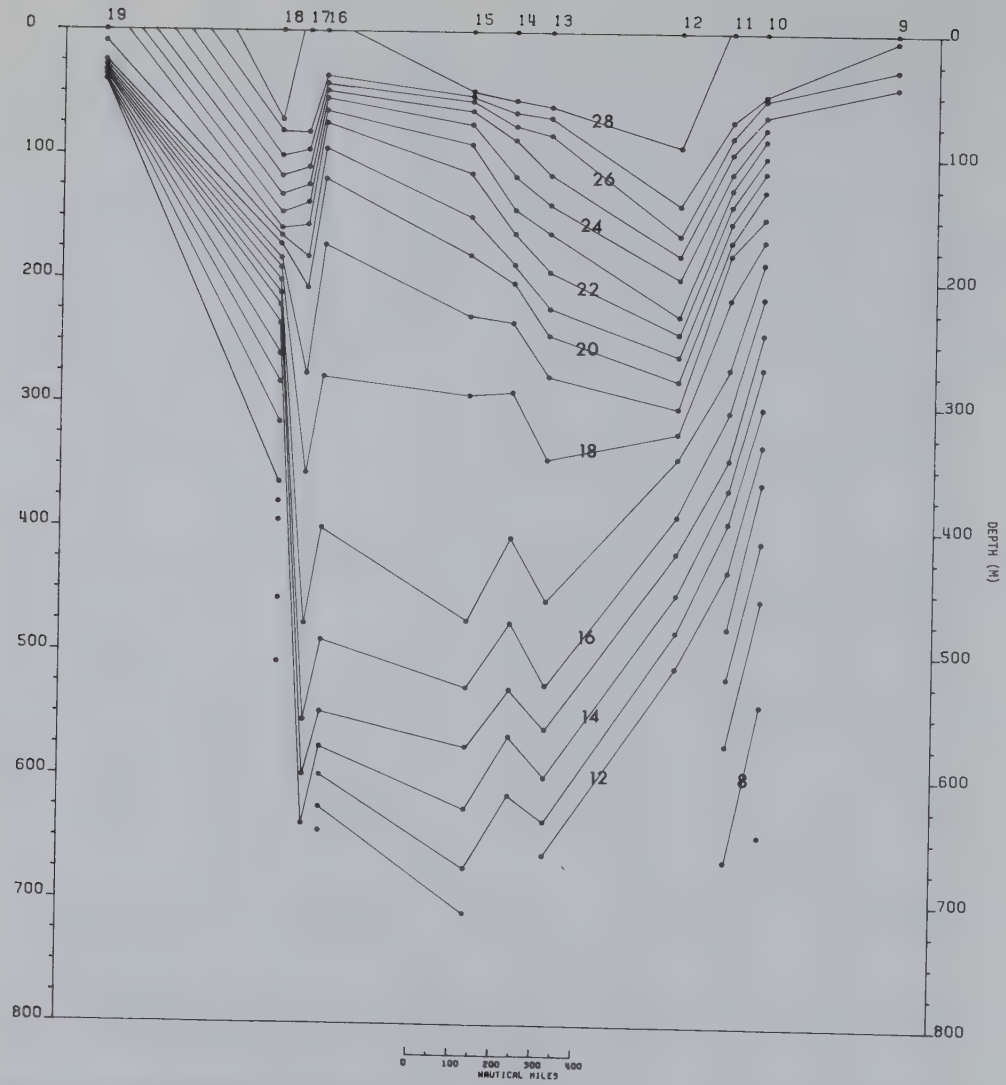


Figure 64.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **2-13 September 1972.**

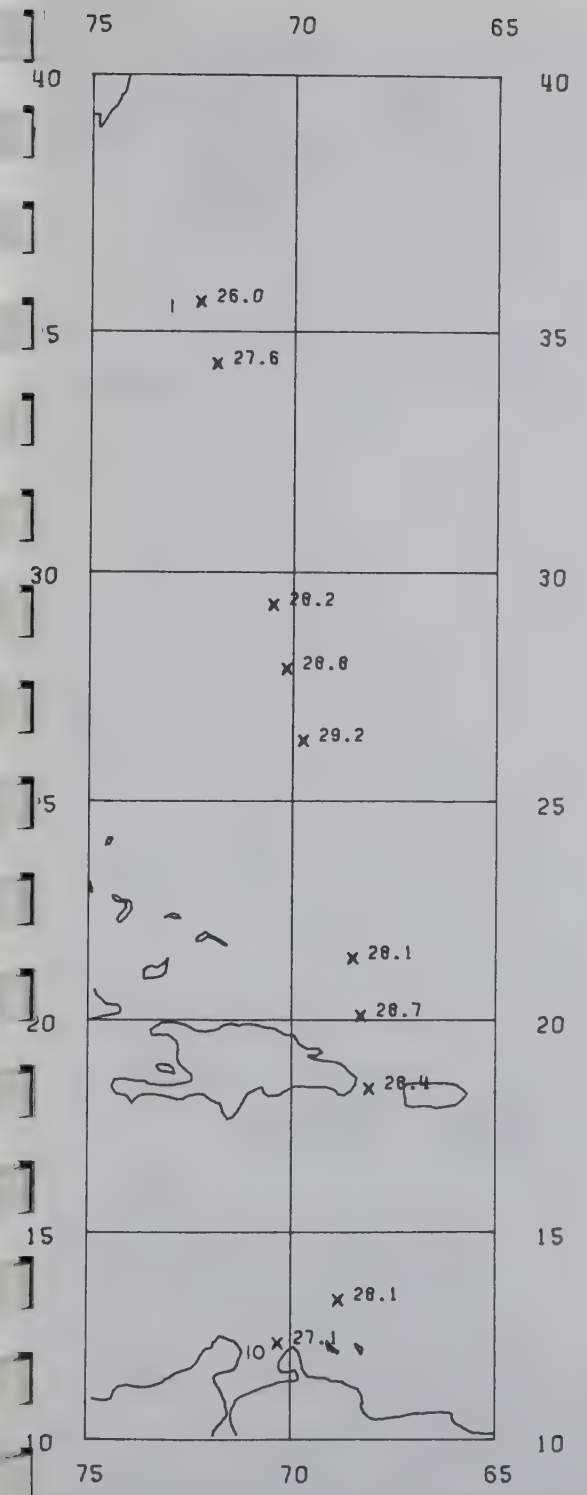


Figure 65.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 17-30 September 1972.

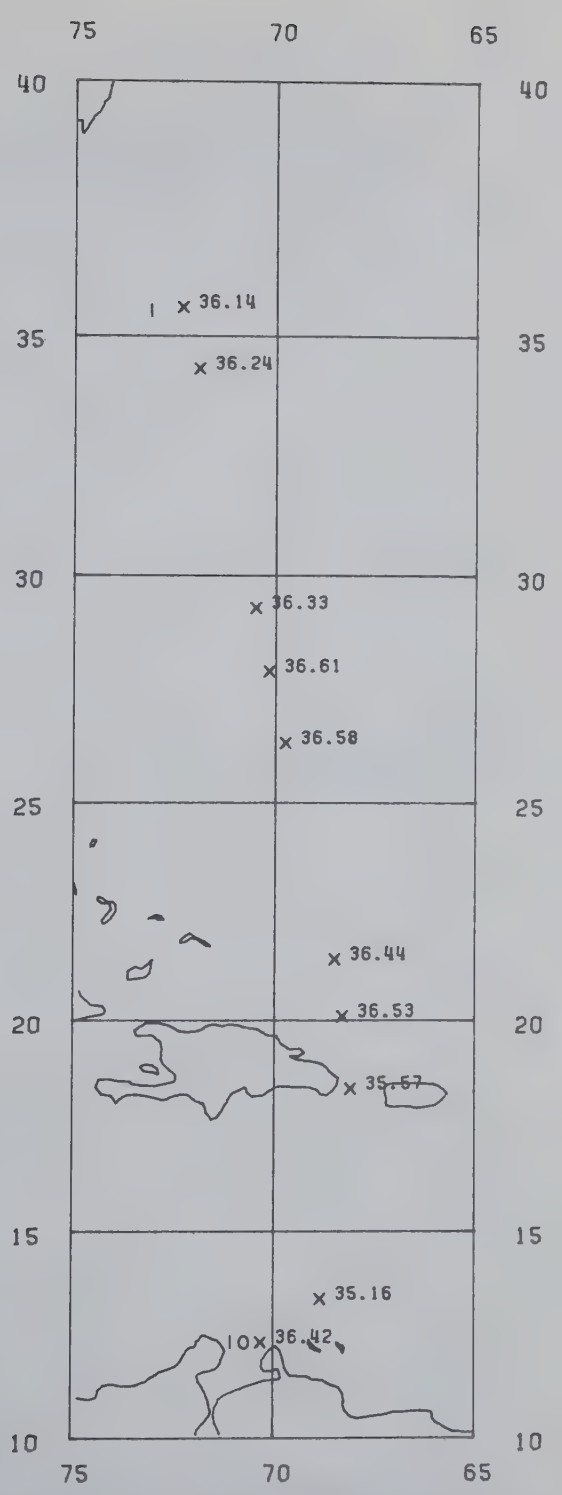


Figure 66.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 17-30 September 1972.

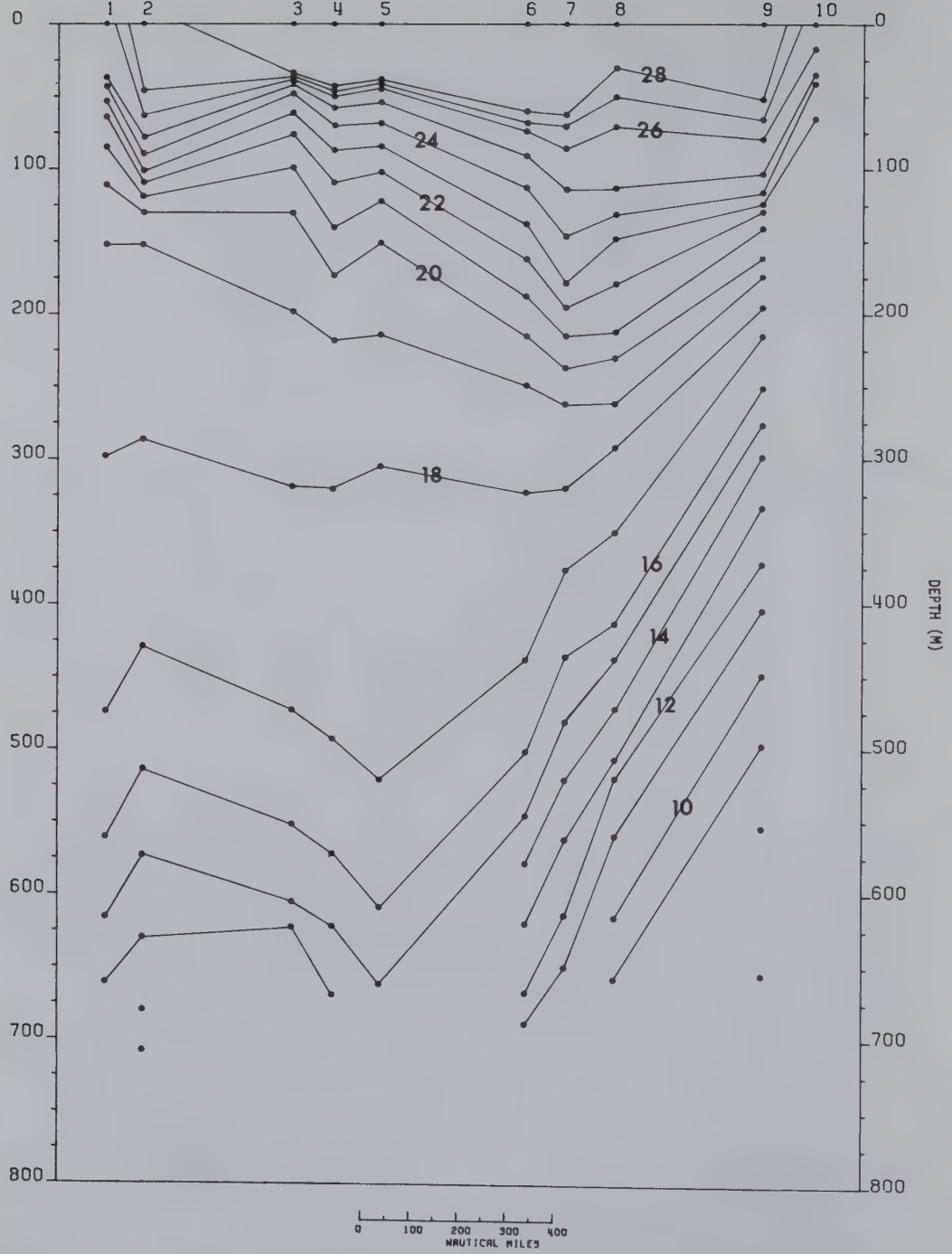


Figure 67.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, 17-30 September 1972.

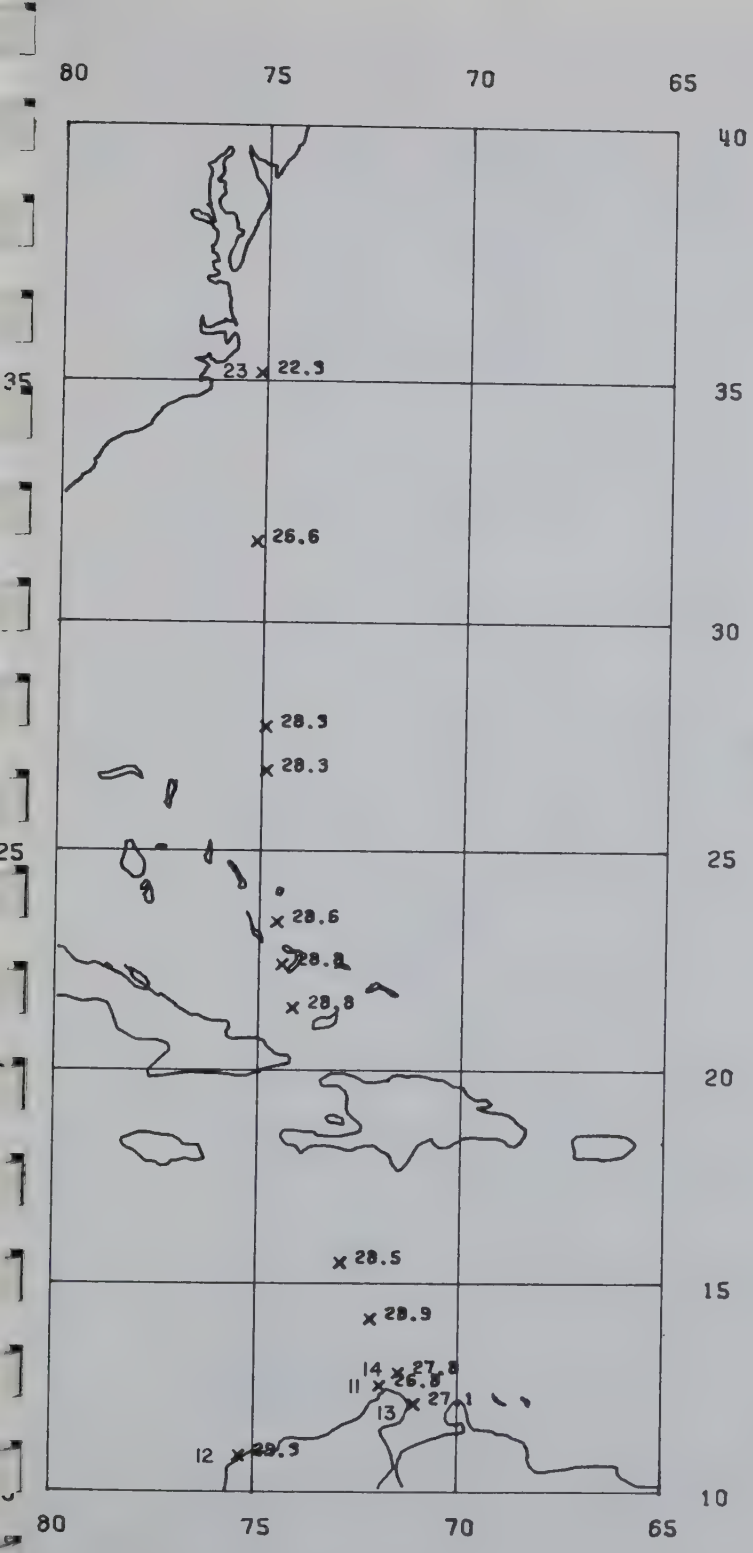


Figure 68.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 30 September-9 October 1972.

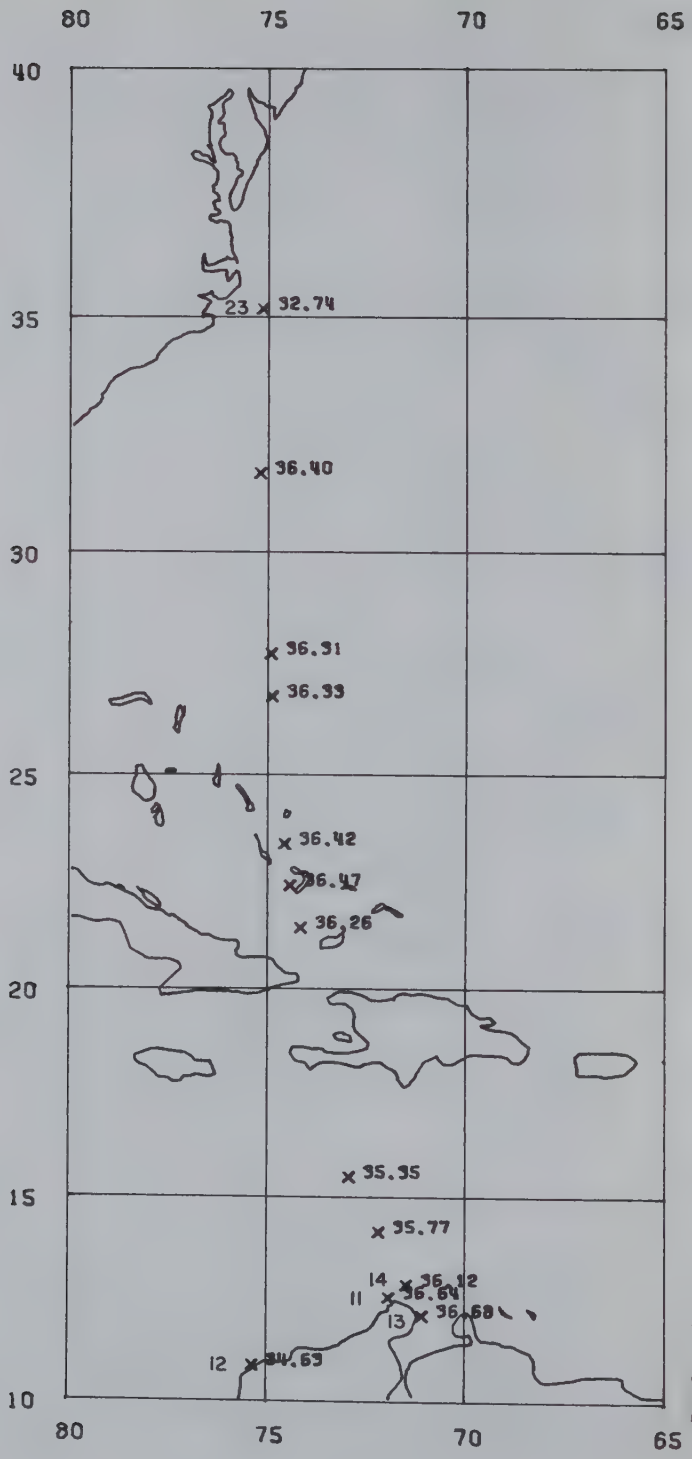


Figure 69.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 30 September-9 October 1972.

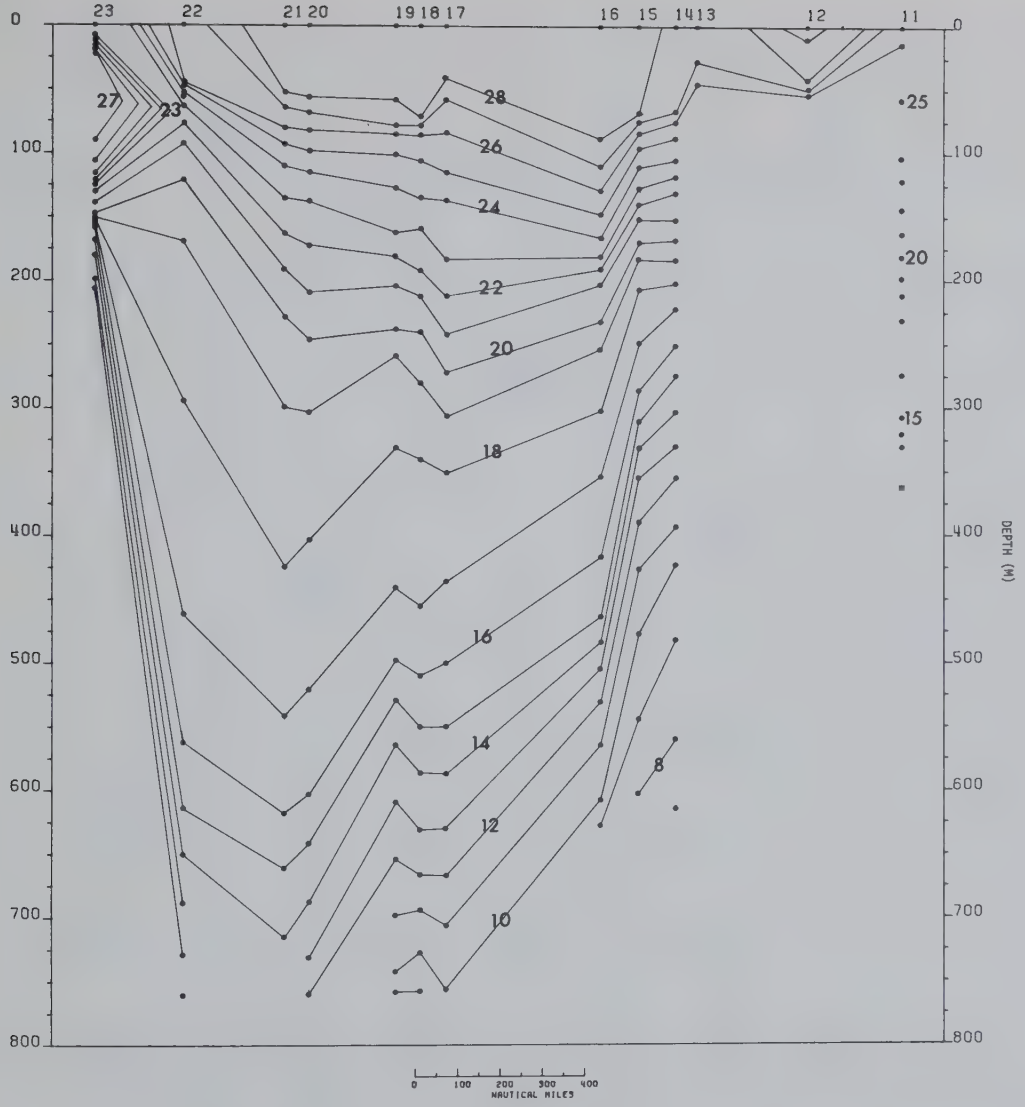


Figure 70.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **30 September-9 October 1972.**

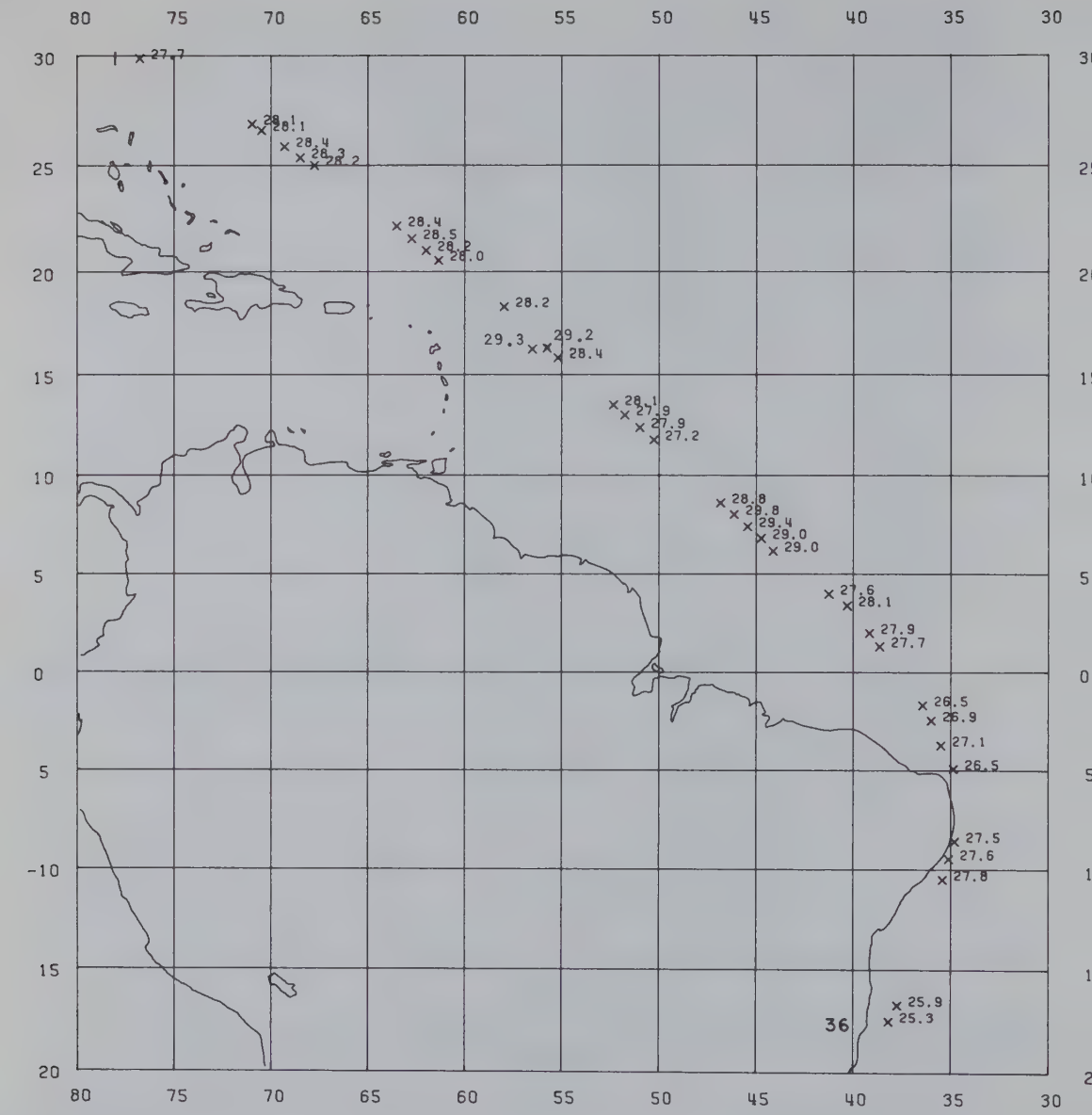


Figure 71.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Pride*, **4-13 October 1972.**

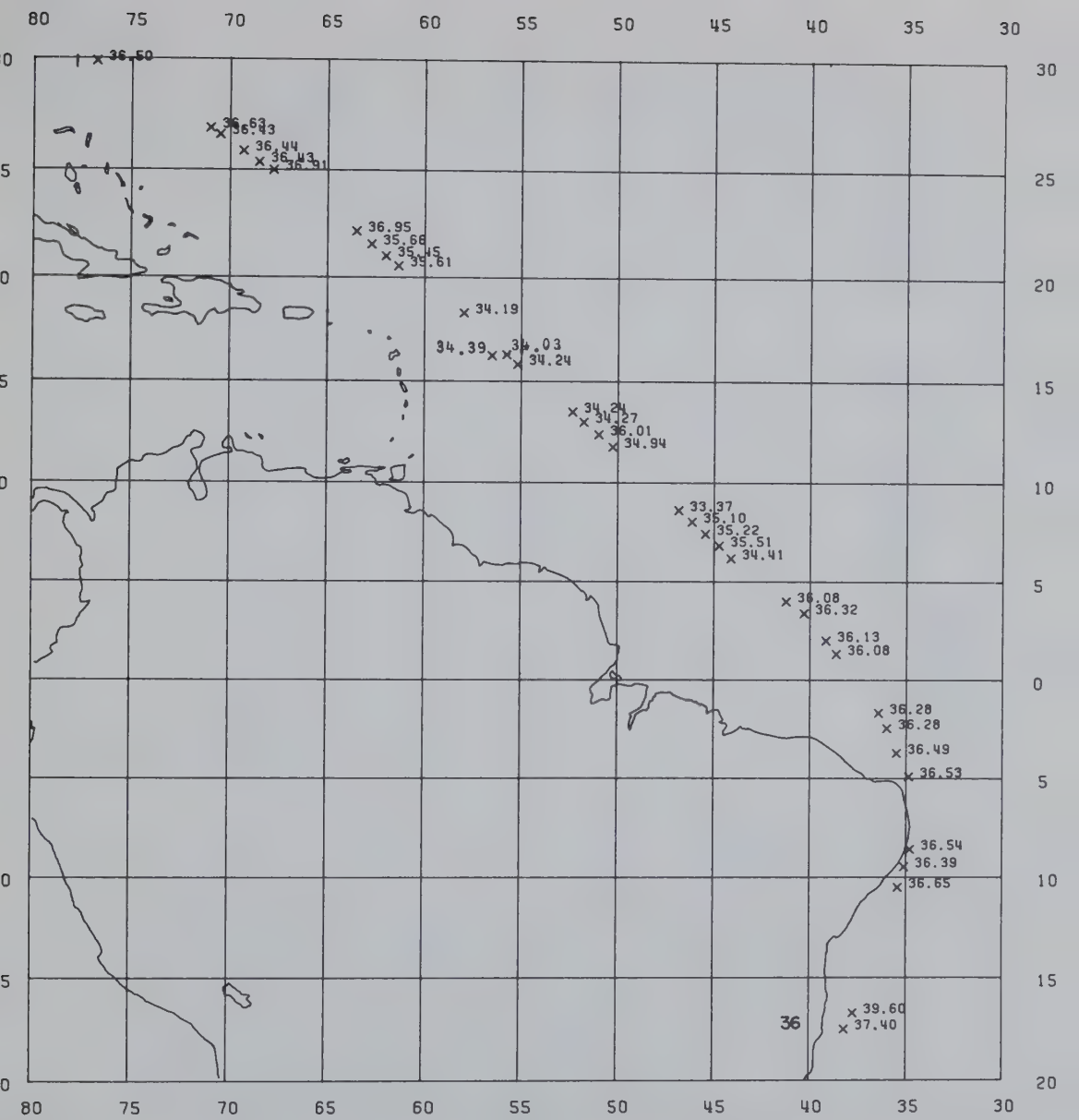


Figure 72.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Mormac Pride*, **4-13 October 1972.**

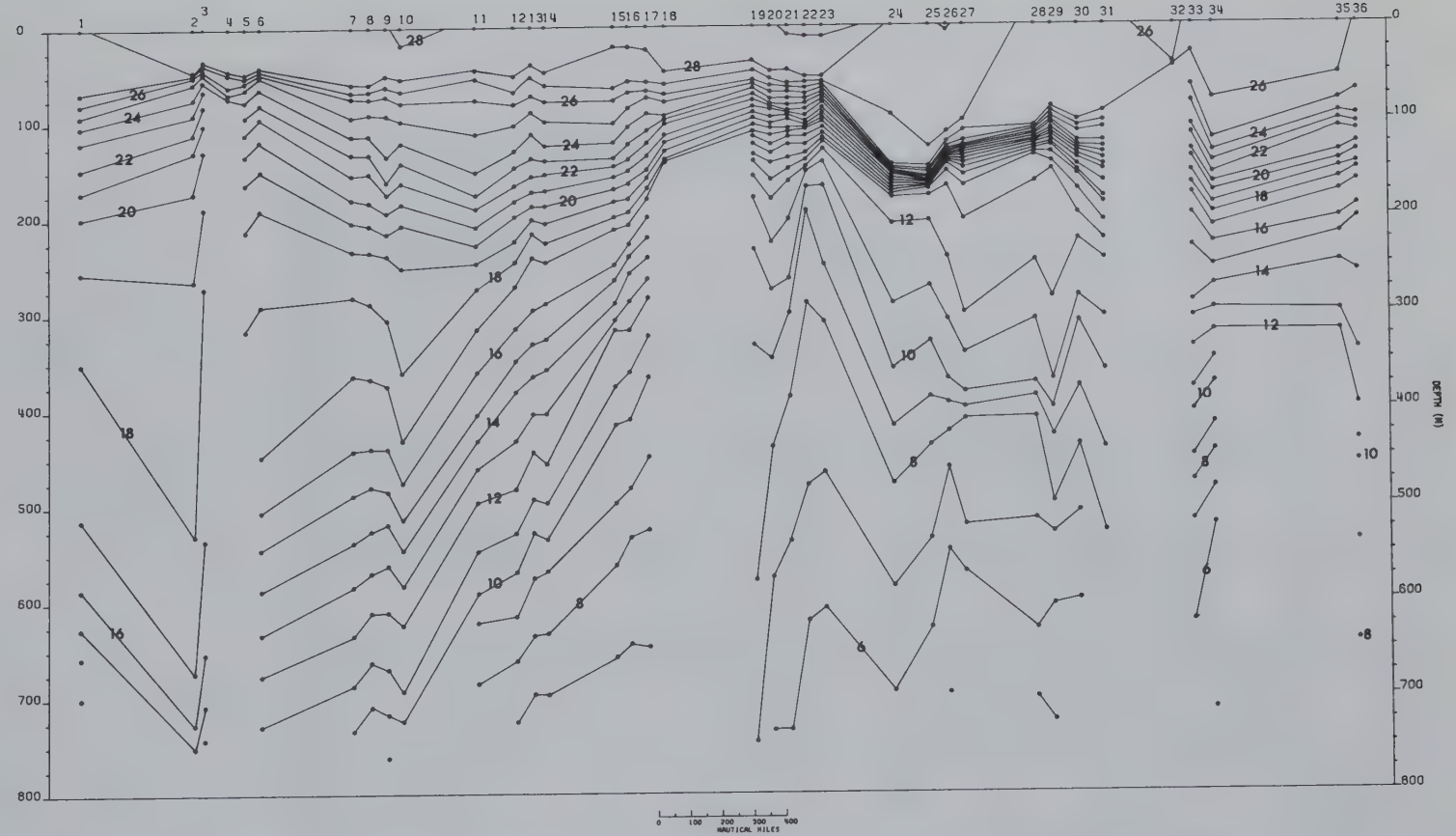


Figure 73.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Pride*, 4-13 October 1972.

Figure 74.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 15-18 October 1972.

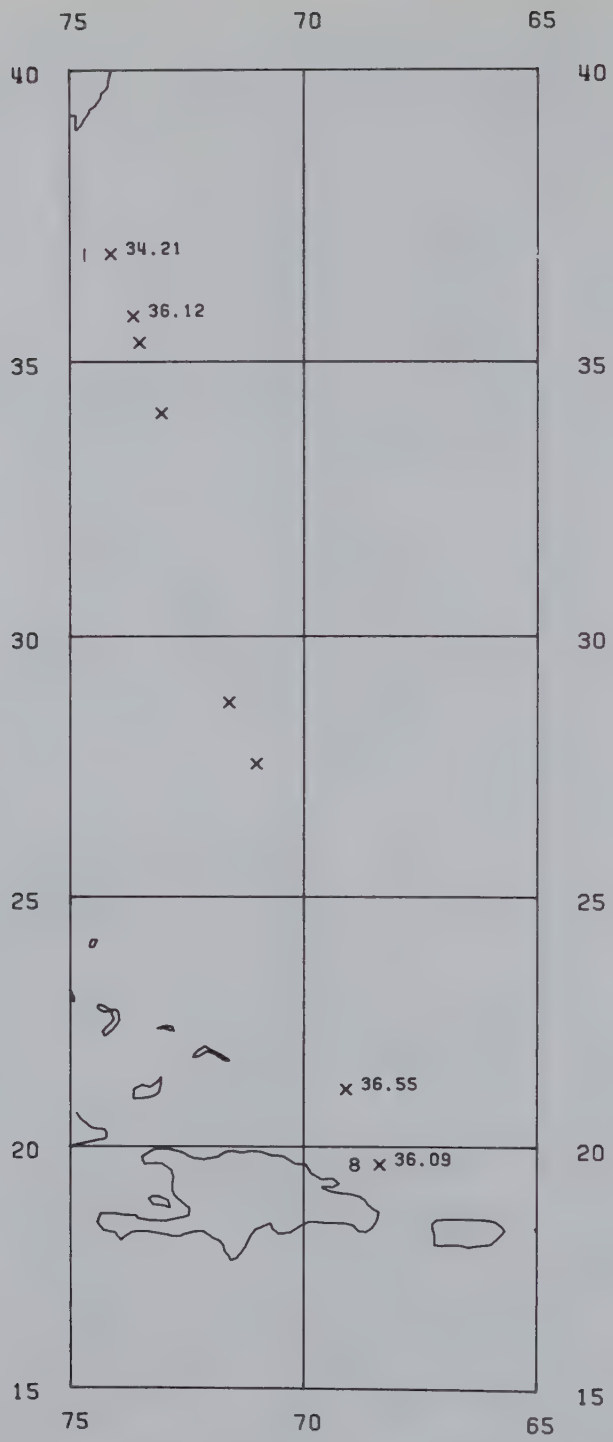
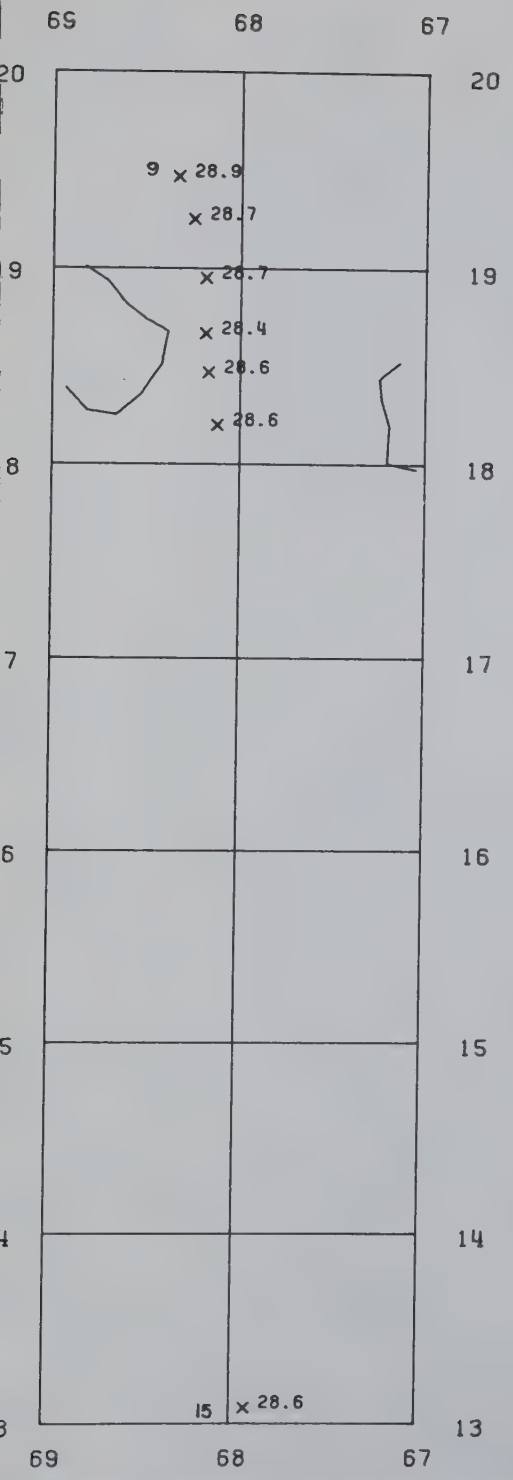


Figure 75.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz,* **15-18 October 1972.**



76.—Sea surface temperature (°C) along the cruise track with st and last stations numbered. *Santa Cruz*, 15-18 October 1972.

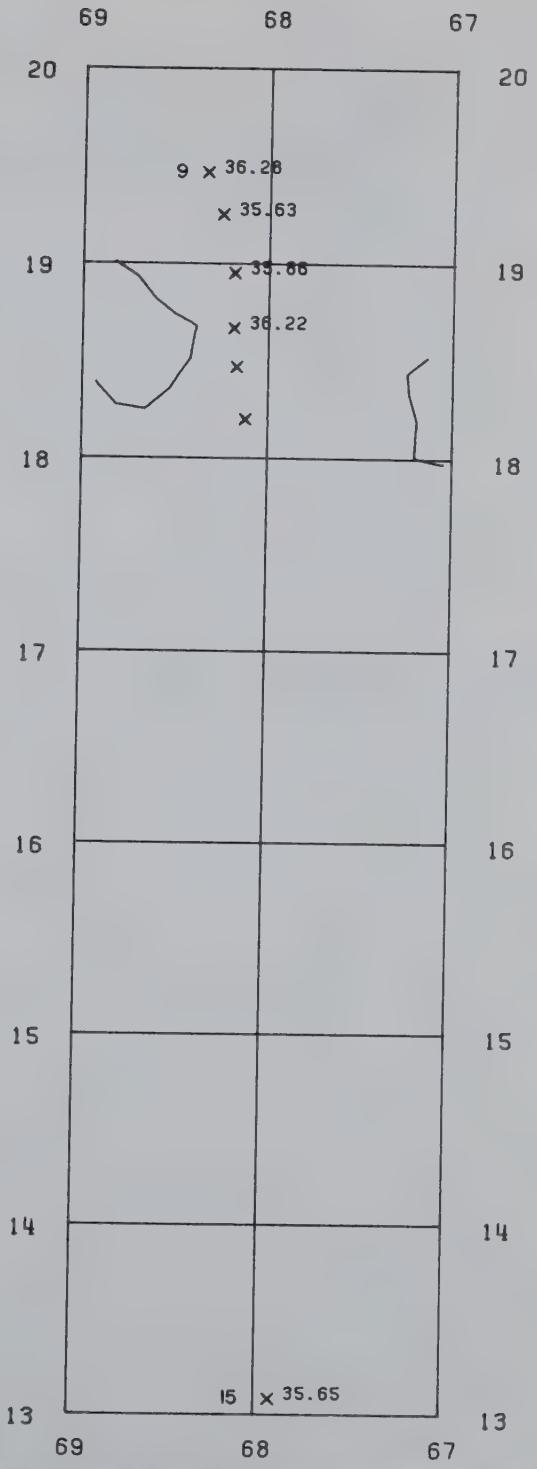


Figure 77.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 15-18 October 1972.

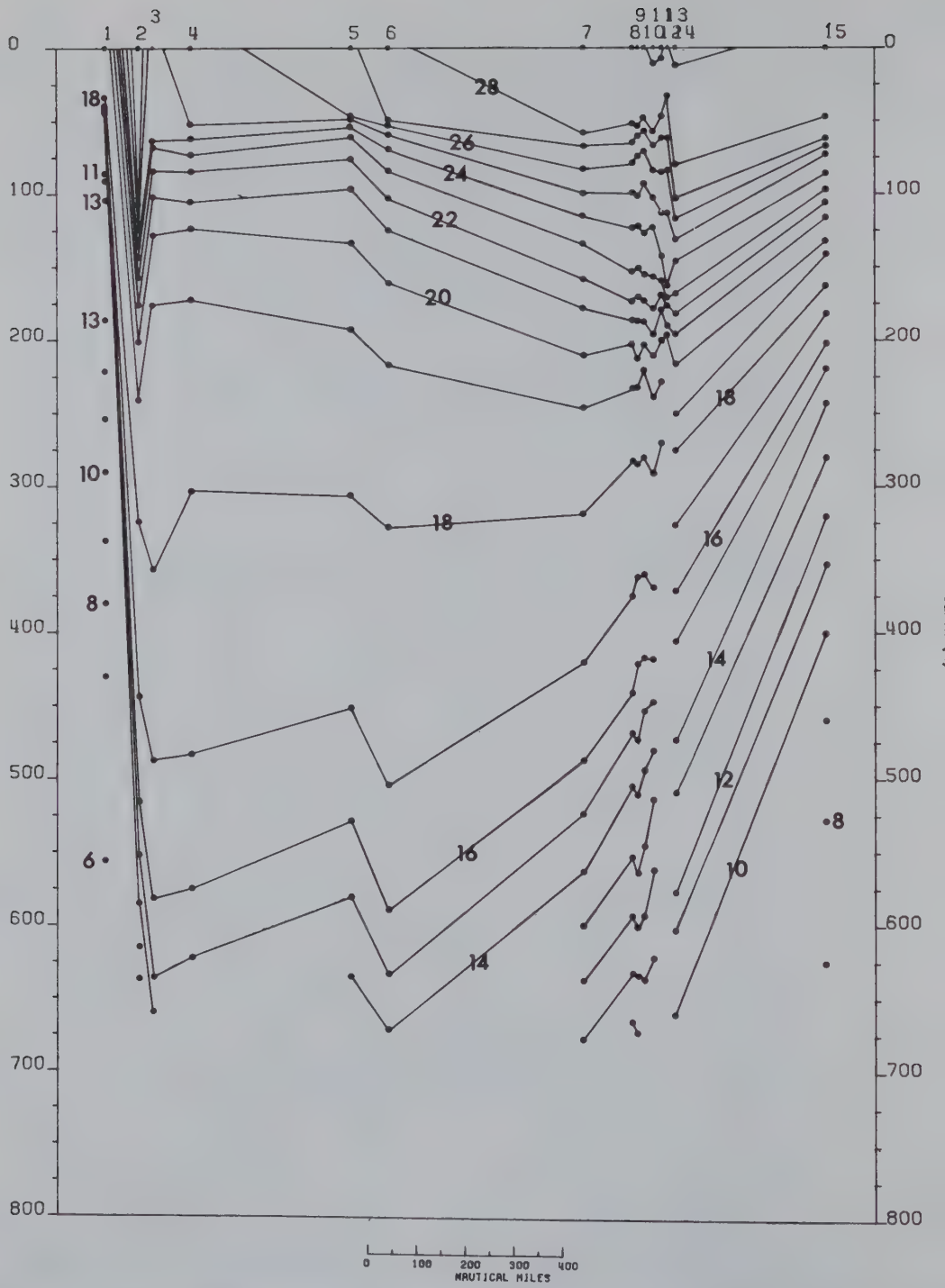


Figure 78.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **15-18 October 1972.**

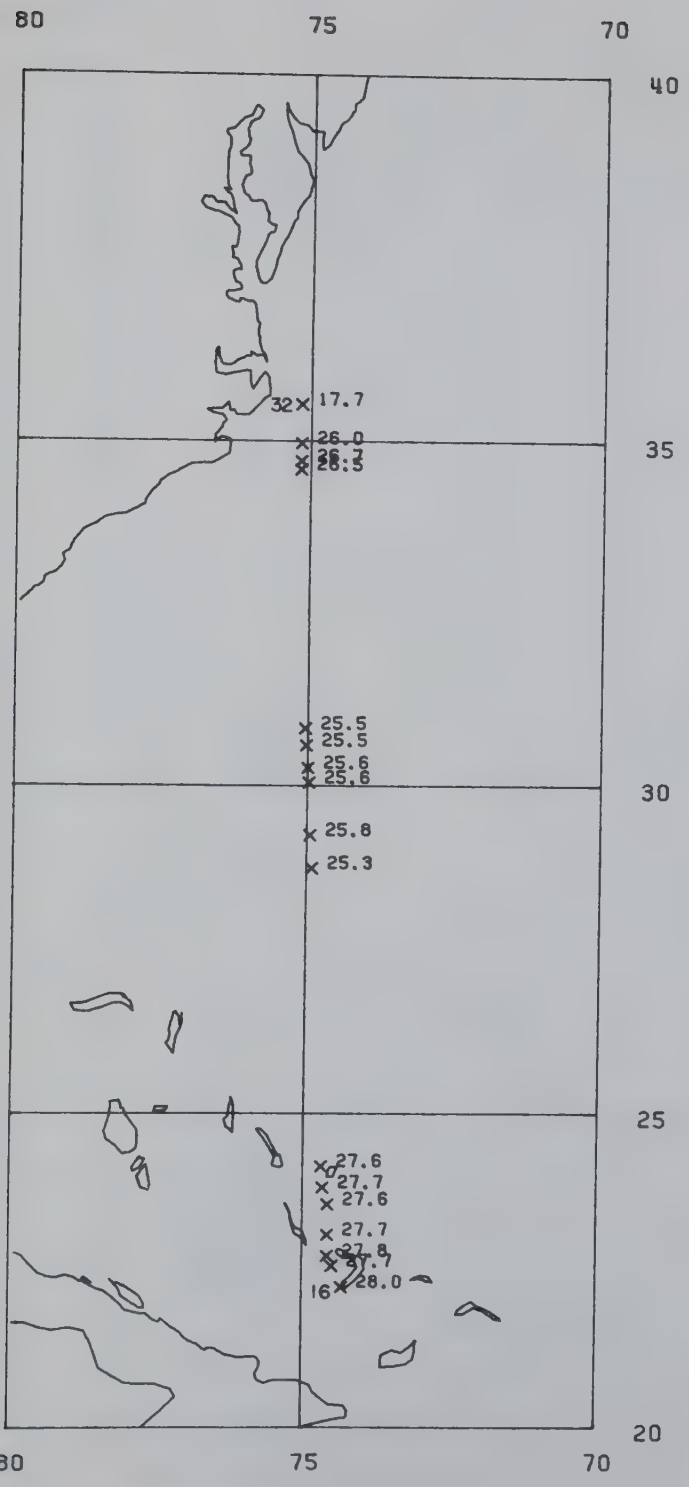


Figure 79.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **3-5 November 1972.**

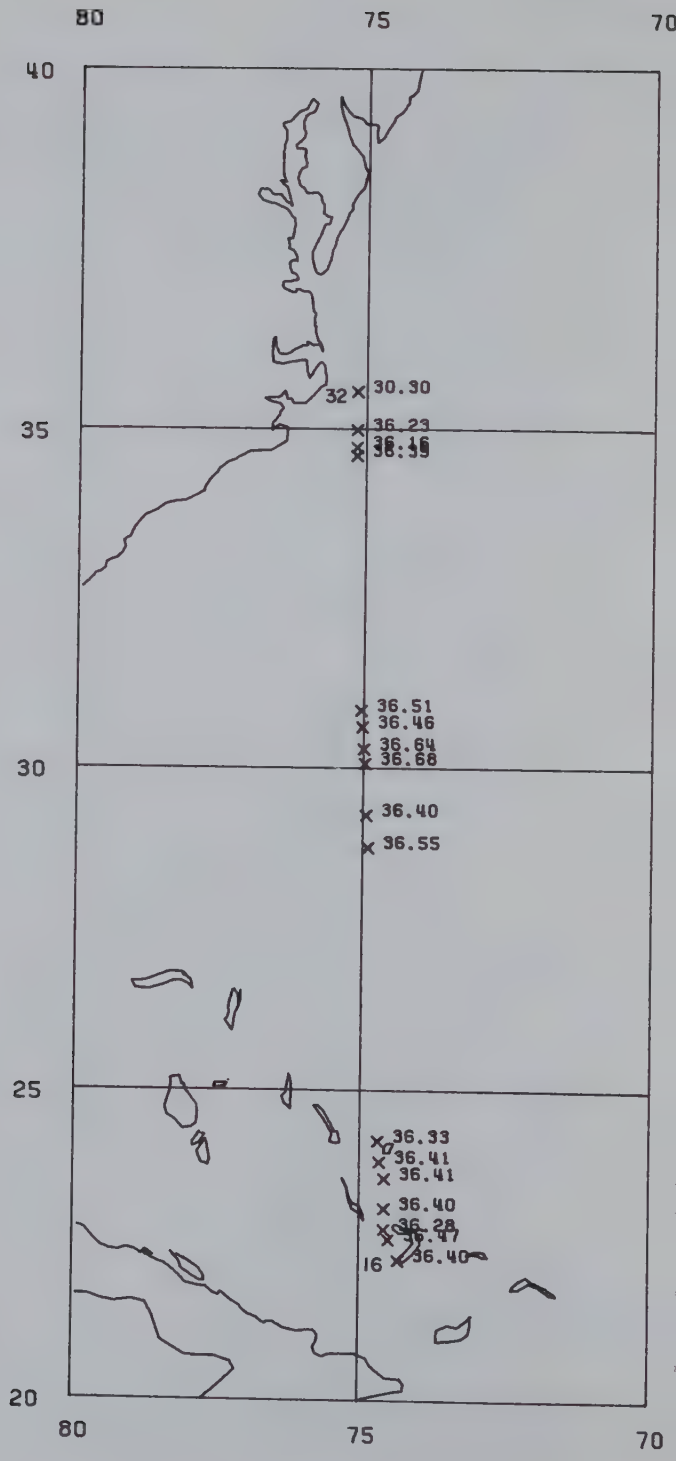


Figure 80.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **3-5 November 1972.**

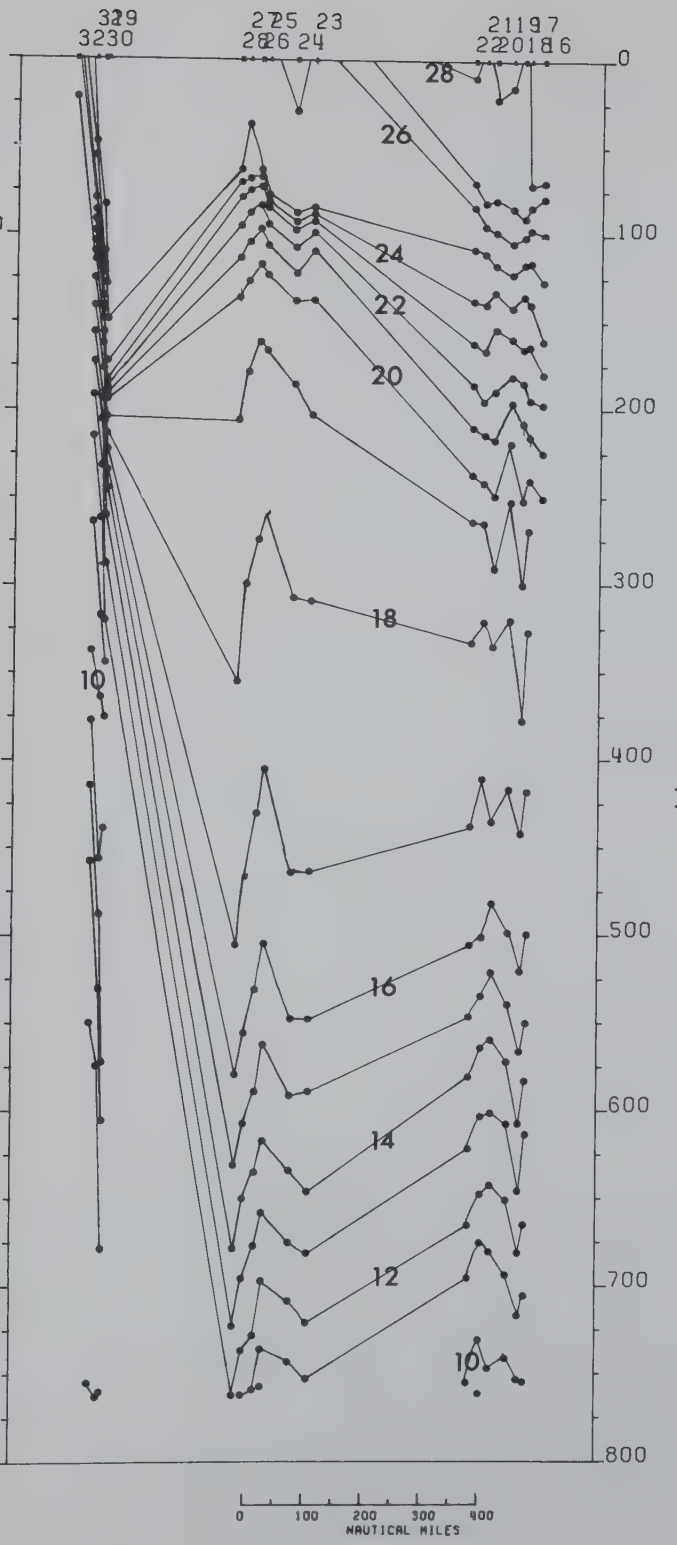


Figure 81.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **3-5 November 1972.**

☆ U. S. GOVERNMENT PRINTING OFFICE: 1975—698-711 /37 REGION 10

eight loss of pond-raised channel catfish (*Ictalurus punctatus*) during holding in ng plant vats. By Donald C. Greenland and Robert L. Gill. December 1971, iii + 7 s., 2 tables. For sale by the Superintendent of Documents, U.S. Government Office, Washington, D.C. 20402.

stribution of forage of skipjack tuna (*Euthynnus pelamis*) in the eastern tropical By Maurice Blackburn and Michael Laurs. January 1972, iii + 16 pp., 7 figs., 3 For sale by the Superintendent of Documents, U.S. Government Printing Office, on, D.C. 20402.

fects of some antioxidants and EDTA on the development of rancidity in Spanish el (*Scomberomorus maculatus*) during frozen storage. By Robert N. Farragut. y 1972, iv + 12 pp., 6 figs., 12 tables. For sale by the Superintendent of nts, U.S. Government Printing Office, Washington, D.C. 20402.

e effect of premortem stress, holding temperatures, and freezing on the stry and quality of skipjack tuna. By Ladell Crawford. April 1972, iii + 23 pp., 3 tables. For sale by the Superintendent of Documents, U.S. Government Printing Washington, D.C. 20402.

e use of electricity in conjunction with a 12.5-meter (Headrope) Gulf-of-Mexico rawl in Lake Michigan. By James E. Ellis. March 1972, iv + 10 pp., 11 figs., 4 For sale by the Superintendent of Documents, U.S. Government Printing Office, gton, D.C. 20402.

electric detector system for recovering internally tagged menhaden, genus a. By R. O. Parker, Jr. February 1972, iii + 7 pp., 3 figs., 1 appendix table. For he Superintendent of Documents, U.S. Government Printing Office, Washington, 402.

mobilization of fingerling salmon and trout by decompression. By Doyle F. nd. March 1972, iii + 7 pp., 3 figs., 2 tables. For sale by the Superintendent of nts, U.S. Government Printing Office, Washington, D.C. 20402.

he calico scallop, *Argopecten gibbus*. By Donald M. Allen and T. J. Costello. May + 19 pp., 9 figs., 1 table. For sale by the Superintendent of Documents, U.S. ent Printing Office, Washington, D.C. 20402.

aking fish protein concentrates by enzymatic hydrolysis. A status report on and some processes and products studied by NMFS. By Malcolm B. Hale. er 1972, v + 32 pp., 15 figs., 17 tables, 1 appendix table. For sale by the ndent of Documents, U.S. Government Printing Office, Washington, D.C.

st of fishes of Alaska and adjacent waters with a guide to some of their literature. C. Quast and Elizabeth L. Hall. July 1972, iv + 47 pp. For sale by the Superinten- Documents, U.S. Government Printing Office, Washington, D.C. 20402.

e Southeast Fisheries Center bionumeric code. Part I: Fishes. By Harvey R. L., Richard B. Roe, and Judith C. Gatlin. July 1972, xi + 95 pp., 2 figs. For sale by erintendent of Documents, U.S. Government Printing Office, Washington, D.C.

reshwater fish electro-motivator (FFEM)-its characteristics and operation. By Ellis and Charles C. Hoopes. November 1972, iii + 11 pp., 9 figs.

review of the literature on the development of skipjack tuna fisheries in the cen- western Pacific Ocean. By Frank J. Hester and Tamio Otsu. January 1973, iii + ig. For sale by the Superintendent of Documents, U.S. Government Printing Of- hington, D.C. 20402.

662. Seasonal distribution of tunas and billfishes in the Atlantic. By John P. Wise and Charles W. Davis. January 1973, iv + 24 pp., 13 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

663. Fish larvae collected from the northeastern Pacific Ocean and Puget Sound during April and May 1967. By Kenneth D. Waldron. December 1972, iii + 16 pp., 2 figs., 1 table, 4 appendix tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

664. Tagging and tag-recovery experiments with Atlantic menhaden, *Brevoortia tyrannus*. By Richard L. Kroger and Robert L. Dryfoos. December 1972, iv + 11 pp., 4 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

665. Larval fish survey of Humbolt Bay, California. By Maxwell B. Eldridge and Charles F. Bryan. December 1972, iii + 8 pp., 8 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

666. Distribution and relative abundance of fishes in Newport River, North Carolina. By William R. Turner and George N. Johnson. September 1973, iv + 23 pp., 1 fig., 13 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

667. An analysis of the commercial lobster (*Homarus americanus*) fishery along the coast of Maine, August 1966 through December 1970. By James C. Thomas. June 1973, v + 57 pp., 18 figs., 11 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

668. An annotated bibliography of the cunner, *Tautogolabrus adspersus* (Walbaum). By Fredric M. Serchuk and David W. Frame. May 1973, ii + 43 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

669. Subpoint prediction for direct readout meteorological satellites. By L. E. Eber. August 1973, iii + 7 pp., 2 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

670. Unharvested fishes in the U.S. commercial fishery of western Lake Erie in 1969. By Harry D. Van Meter. July 1973, iii + 11 pp., 6 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

671. Coastal upwelling indices, west coast of North America, 1946-71. By Andrew Bakun. June 1973, iv + 103 pp., 6 figs., 3 tables, 45 appendix figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

672. Seasonal occurrence of young Gulf menhaden and other fishes in a northwestern Florida estuary. By Marlin E. Tagatz and E. Peter H. Wilkins. August 1973, iii + 14 pp., 1 fig., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

673. Abundance and distribution of inshore benthic fauna off southwestern Long Island, N.Y. By Frank W. Steimle, Jr. and Richard B. Stone. December 1973, iii + 50 pp., 2 figs., 5 appendix tables.

674. Lake Erie bottom trawl explorations, 1962-66. By Edgar W. Bowman. January 1974, iv + 21 pp., 9 figs., 1 table, 7 appendix tables.

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SCIENTIFIC PUBLICATIONS STAFF
ROOM 450
1107 N.E. 45TH ST.
SEATTLE, WA 98105
OFFICIAL BUSINESS

FOURTH CLASS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210

Southwest Fisheries Center
NMFS, NOAA Hawaii S
P. O. Box 3830
Hononlulu, Hi 96812

AMERICAN REVOLUTION BICENTENNIAL
1776-1976